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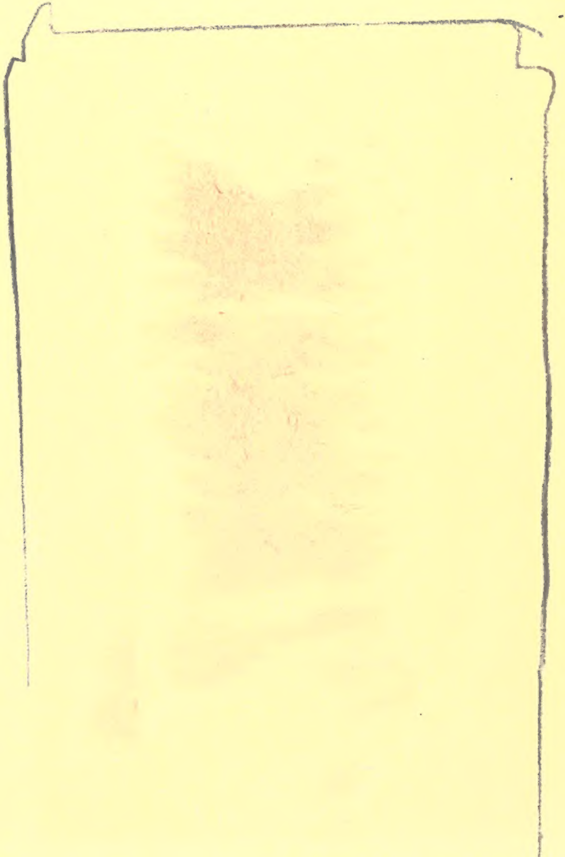

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# THE PRINCIPLES OF HEALTH CONTROL

BY

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> "*To be a good animal is the first requisite to success in life, and to be a nation of good animals is the first condition to national prosperity.*"
> —HERBERT SPENCER

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# PREFACE

A chief difference between the present volume and the usual textbooks upon hygiene lies in the emphasis that is placed upon corrective work. Advantage is taken of the fact that perfect health is rarely attained, to place before the student the problem of improving his physical condition and of testing in a simple manner the principles which he is studying.

Health control, from the author's viewpoint, presents a negative and a positive phase — negative in so far as the causes of disease and bodily weakness are to be avoided, positive to the extent that weak parts are to be built up, body processes improved, and the natural defenses strengthened. Although these phases are of about equal importance, the second supplies an impelling motive for the student and fills an ever-increasing need in the life of today.

Since all phases of modern life tend to impair the physical organism, there should be a wide dissemination of the knowledge of how weaknesses are to be relieved and the body restored to its normal condition. This does not mean that less attention should be given to prevention, but that more should be given to counteractive and recuperative agencies.

In requiring corrective work of students, however, care must be exercised. The conditions which we attempt to improve must be such as yield to well-defined hygienic agencies, and the remedies suggested must do no harm. Those under the physician's care must be guided by his advice or excused entirely. The student should never be made to feel that he is submitting in a medical sense to any form of treatment, but should be made to realize that his health and vigor depend largely upon his own efforts. All problems of a serious nature, or upon which the effects of hygienic measures may be doubtful, should be referred to the physician. As an incentive to the formation of correct habits and the relief of bodily weaknesses the student may be given a health grade, based largely upon the improvements which he is able to attain, which shall count in determining his final standing.

Concerning the general theme of the book a few qualifying statements are perhaps in order. In accepting the theory of *health control* as a working basis, it is necessary to construe it in a broad and general sense. The "laws of health" permit no such rigid application as the laws of mechanics or of chemical action and, because of structural and functional differences among individuals, health agencies can with no degree of accuracy be standardized. Hence, as long as "one man's meat is another's poison," the system of control which is effective with one person is likely to fail with another. Although this fact is not opposed to the idea of control, it does mean that success must largely depend upon the careful adjustment of recognized principles to individual needs.

Again we must distinguish between the methods of control which the individual can exercise over his own health and those which, on account of his social, economic, and biological dependence, must be exercised for him by others. Control by the individual has well-defined limitations. But the individual may, through intelligent coöperation with others, become a factor in the larger control which is exercised through organized society.

Certainly one purpose of a course in hygiene is to instruct prospective citizens concerning the problems of public health and the methods by which they are to coöperate with physicians, health officers, and with one another, in their solution. In addition to the rather full discussion of social agencies in their relation to health (Chapter XX), it is recommended that special emphasis be placed upon this work in the daily recitations. While hygienic effort very properly begins with self, it must not be permitted to end here, and for the reason that the larger control of health comes through the social order.

An earnest effort has been made to place every phase of the subject upon the basis of *cause and effect* and to eliminate as far as possible the interminable maze of guesswork which is the bane of much hygiene teaching. That every sound principle has its basis in some physiological condition is axiomatic, and to portray the means through which a given cause produces its effect is necessary to correct teaching and thinking. To facilitate the work of reviewing such facts of physiology as underlie health principles, and to which only brief reference can be made, occasional page references are given to two high school physiologies — Hough and Sedgwick's *The Human Mechanism* and the author's *Physiology and Hygiene for Secondary Schools.* For investigating topics that go beyond the present text in matters of hygiene, Rosenau's *Preventive Medicine and Hygiene* and Harrington's *A Manual of Practical Hygiene* are earnestly recommended. For collateral reading, Gulick's *Efficient Life*, Pyle's *Personal Hygiene*, Galbraith's *Personal Hygiene and Physical Culture for Women*, Allen's *Civics and Health*, Hoag's *Health Index of Children*, Drummond's *An Introduction to School Hygiene*, and Coleman's *The People's Health* will prove most interesting and helpful.

Valuable suggestions in the preparation of this book have been received from Dr. Harold B. Keyes, Assistant Professor of Physical Education, Columbia University, New York; Dr. Joseph E. Raycroft, Professor of Hygiene and Physical Education, Princeton University; Dr. Paul C. Phillips, Professor of Hygiene and Physical Education, Amherst College; Dr. Mazyck P. Ravenel, Professor of Preventive Medicine, University of Missouri; Professor F. M. Gregg, State Normal School, Peru, Neb.; Dr. D. T. Kizer, State Normal School, Springfield, Mo.; Dr. Amos T. Fisher, of the Medical Staff of Missouri State Hospital No. 2; Dr. G. Bruce Lemmon, practicing physician and Ex-Commissioner of Health, Springfield, Mo.; Dr. Louis Murbach, Central High School, Detroit, Mich.; and my colaborers in the Warrensburg (Mo.) State Normal School, Messrs. E. L. Hendricks, H. A. Phillips, R. A. Gantz, C. A. McPheeters, Geo. R. Crissman, Forrest C. Allen, and Misses Laura L. Runyon, Elizabeth Nowell and Leta E. Harsell, most of whom read the entire manuscript. To these, as well as to numerous students in the hygiene classes who have assisted in testing health principles, the author is profoundly grateful.

F. M. W.

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# THE PRINCIPLES OF HEALTH CONTROL

## CHAPTER I

### INTRODUCTION

THERE are many reasons why every person should give much attention to his physical condition, or health. Continued good health means avoidance of the pain, inconvenience, and danger incident to disease—and it means much more besides. It supplies a basis for all that is best in life.

**Health and Efficiency.**—Dependent upon good health is one's efficiency, *i. e.*, his power to do well some kind of work. The main elements in efficiency are skill, the will to do, and bodily energy. While skill is attained through toil and study, and strength of will depends upon native disposition, training, and good health, bodily energy depends solely upon good health. If energy is lacking, the brain and muscles are as engines without steam, so that skill and the will to do count for naught. Because of this fact, poor health is a source of great financial loss to the workman. Not only is there loss when work must stop from sickness or when a diminished or inferior product results from one's not being at his best, but poor health also keeps the individual from developing into the high-priced workman which he otherwise might become.

**Health and Happiness.** — The human being presents two phases of life, distinct, but parallel — the physical or animal life and the psychic or mental life. The term happiness is used to express a general condition, or state, of the mind. If the mental life is of an agreeable nature, one is said to be happy; if disagreeable, unhappy. Bodily weakness and disease, even in their mildest forms, interfere with the normal activity of the brain, thereby producing conditions that cause the mental states to be very easily perturbed or excited. Even when the unhappiness is attributed to petty annoyances, reverses in fortune, disappointment, or other external causes, poor health is usually to blame. Improve the health and the ordinary experiences of life no longer stir up unhappy feelings. Other factors in the causation of happiness are of minor importance in comparison with good health.

**Health and Personal Attractiveness.** — Good health is said to be the most important of all beautifiers, and there are two reasons why this statement is true. In the first place, good health, by its effect on the mental states, causes one to be cheerful, agreeable, and vivacious. In the second place, it gives the beautiful complexion and the body poise and symmetry which enhance the physical appearance. Through the combination of these qualities we become attractive to others. Poor health, on the other hand, renders one less attractive both from the standpoint of disposition and of appearance.

**Health and Length of Life.** — Length of life is another prize whose possession is made possible through good health. Most people die, not from the natural wearing out of the body, but from the various ills to which flesh is heir. Long before the period of natural decline, the body is so weakened by some disease (usually preventable) that life can no longer be kept up. But the prolongation of the physical life is regarded by most people as undesirable, if one is to become, as many old people do, inefficient and unhappy. Good health, while increasing the years, prolongs the period of efficiency, and in many instances makes the latter part of life more enjoyable and profitable than the earlier years. The long list of notable men and women who have maintained their efficiency to an advanced age is suggestive of the possibilities for good of a period of life too often fraught with suffering and incompetency.

**Health and Racial Vigor.** — Healthy parents produce healthy offspring, while the children of those diseased, or simply run down in health, are in most instances physically weak. When health or weakness is repeated through several generations, it becomes a characteristic in the line of descent and, if sufficiently widespread, becomes a characteristic of the race or the nation. Proof that wide differences in vigor exist among peoples is found in the vital statistics of different countries. In Sweden, at the present time, the average length of life is fifty-two and one-fourth years, being considerably greater than that of any other country. And it is interesting to note in this connection that perhaps no other country gives such careful attention to all matters pertaining to health and physical development as does Sweden.

**Health a Controllable Condition.** — Of special importance in connection with the foregoing statements is the fact, now fully established, that the state of one's health can be controlled from day to day. By observing certain conditions we are able to secure and maintain good health; if we neglect these conditions we permit our health to decline. This places the individual in a position of power and also of responsibility — power in that it enables him to secure the advantages derived through good health; responsibility, since financial loss, bodily suffering, and general failure are likely to result if he does not exercise the control which he should. There is much need for education along these lines. That people generally feel too little responsibility for their health is evidenced by their attitude of mind and by their failure to avoid diseases and accidents that are easily preventable.

But health control is a problem of society as well as of the individual. By working together people can establish general conditions essential to health, thereby placing life in all of its phases upon a more secure foundation. The problem of the public health, however, has not as yet received the attention which it deserves.

**Health Conservation a National Problem.** — Highly suggestive in its relation to health is the interest now manifested in the proper use and management of our natural resources. Experience has taught that soil fertility is easily exhausted, that forests are quickly destroyed, both by the ruthless ax and by fire, that rich mines may be so worked as to waste much of their wealth of mineral, and that our water courses may fail in large measure to serve the purposes which they are capable of serving. While the wisdom of such conservation has not been overestimated, its importance depends upon the needs of man. It is the relation which our natural resources sustain to human life and health that makes their proper use and preservation so necessary.

If, then, as a nation we must concern ourselves with the conservation of our natural resources, how much more should we be concerned with the physical development and vigor of our people. Because life and health are more than the things upon which they depend, their conservation should be ranked first among such problems.

**Hygiene Defined.** — Out of the experience of the race and as a result of study and investigation, much knowledge bearing upon the problems of health control has been accumulated. This has been classified and organized and, under the name of hygiene (Greek, *hygeia*, health), has become a subject of general study. Influences and conditions making for good health are said to be hygienic; those making for ill health, unhygienic. From the point of view of our present study, *hygiene* may be defined as *the science of health control.*

**Phases of Hygiene.** — According to the various treatises upon hygiene, the general subject presents the following phases or divisions:

1. Personal hygiene — that pertaining to the care which the individual bestows upon his own health.

2. Domestic hygiene — that having to do with the health oversight of a small group of people, such as a family or a school.

3. Public or general hygiene — that involving regulations pertaining to the physical welfare of an entire community, as a city, state, or nation.

4. Vocational or special hygiene — that having to do with the special health problems of people following the same occupation.

5. Environmental hygiene or sanitation — that phase of hygiene which relates to the effects of the physical surroundings upon the body.

6. Corrective hygiene — the application of hygienic principles to the relief of bodily weaknesses and defects.

7. Preventive medicine — the prevention of particular diseases, e.g., the prevention of smallpox through vaccination.

**Summary.** — Good health is the basis of efficiency, happiness, personal attractiveness, length of life, and racial vigor. Its absence is marked by weakness, suffering, and unrealized ambitions. To control health is a chief problem both of the individual and of society.

**Exercises.** — **1.** Define efficiency. Upon what does it depend? Explain its relation to health.

**2.** Define happiness. Name several conditions essential to happiness. Why is health the most important of such conditions?

**3.** In what ways is personal attractiveness dependent upon good health?

**4.** How does good health increase length of life? How does it make old age efficient and enjoyable?

**5.** Give proofs that health is a controllable condition.

**6.** Define conservation. Why is the conservation of health more important than the conservation of natural resources?

**7.** Enumerate the different phases of hygiene. Are these separate and distinct divisions of the subject, or do they represent different viewpoints from which the subject is studied? Give the reasons for your answer.

# CHAPTER II

## FACTS RELATING TO THE BODY WHICH SUPPLY A BASIS FOR CONTROL

"We can command Nature only as we obey her laws." — *Lyell.*

PREPARATORY to our study of the practical methods of controlling health, we shall consider the conditions which make such control possible. This necessitates inquiry into the nature of health and its relation to conditions and influences in everyday life and this, in turn, a brief survey of the body plan.

**The Body an Organization of Cells.** — Of first importance is the fact, established through biological study, that the body is an organization[1] of minute living particles, called cells. These are composed mainly of a complex substance, known as protoplasm, and are surrounded and held in place by an intercellular material which they form and deposit. Though too small to be seen with the unaided eye, the cells are well-defined bodies, each having several distinct parts. At or near the center of the cell is a clear, round body, called the nucleus, and enclosing the cell on all sides is a thin wall or membrane. Between the nucleus and the cell membrane is the main body, or working constituent of the cell. This contains food material, some waste, and substances necessary to its general and special activities. Near the nucleus is a small body, called the attraction sphere, which coöperates with the nucleus in the formation of new cells when this process is taking place.

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[1] An organization is properly defined as a group of individuals which, in working for a common purpose, practices the division of labor. The definition sets forth three ideas: the "individuals," the "working for a purpose," and the "division of labor." An army, a baseball team, a political party, a hive of bees, and a colony of ants, are all groups which embody the three ideas and are examples of organizations. The individuals, or units, in an organization may be large or small. In the body they are microscopic. (See Chapter iii, Walters' *Physiology and Hygiene*, or Chapters iii and iv, Hough and Sedgwick's *The Human Mechanism.*)

**Importance of the Cells.** — The cells are the living, working parts of the body — the recognized units of structure and of function. Through one kind of work each cell maintains its own existence. By another kind of work it contributes to the welfare of the body, or cell group, of which it is a part. Working together the cells build up the body, keep it in repair, and perform in one way or another the different kinds of service devolving upon it as a whole. In working for the general good, the cells practice the "division of labor," one kind of cells doing one kind of work, and another kind of cells, another. This necessitates their systematic grouping throughout the body.

**Cell Groups or Tissues.** — The cells do not exist singly in the body, but those of the same kind are grouped together, forming the body materials or tissues. In dissecting the body of an animal we find muscle, fat, bone, cartilage, etc. These are the tissues, and each simple tissue is a group of like cells. The grouping together of like cells enables them to combine in their activities and to make their work effective. For example, we have, in the muscles, the combined action of cells for the production of motion, and in the nervous system the combined action of cells for the purpose of control. Likewise each of the other tissues is a combination of cells for the carrying on of work which is to benefit the body as a whole.

**Tissue Groups or Organs.** — The body is made up largely of parts which do different things. The hands grasp or take hold of objects; the heart pumps the blood; the small intestine digests food; the eyes are for seeing, etc. These working parts, called organs, are groups of tissues. Each organ contains just the tissues necessary for its work and these have a special arrangement — one adapted to the work which the organ performs. The hand, for example, has muscular tissue which supplies motion, bony tissue which provides a framework, connective tissue which binds the parts together, and other tissues, serving other purposes.[1]

**Organ Groups or Systems.** — In carrying on the work of the body various organs are able to combine with each other in their several activities. These combinations may be for temporary convenience, as in some work performed by the two hands and guided by the eyes or in some labor which requires both the hands and the feet. More frequently, however, the organs are so connected and arranged as to coöperate continuously in some kind of work. An illustration of this is seen in the digestion of the food — a process which requires the combined action of the mouth, stomach, intestines, liver, and other organs. A number of organs permanently combined for the same work is called a system. The chief systems of the body are the digestive system, the circulatory system, the respiratory system, the muscular system, and the nervous system.

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[1] In addition to forming organs, the tissues enclose cavities for holding organs and supply supports for keeping organs in place. The three largest cavities of the body are the cranial cavity, containing the brain; the thoracic cavity, containing the heart and the lungs; and the abdominal cavity, containing the stomach, liver, intestines, and other important organs.

**Health a Condition of the Cells.** — The grouping of the cells to form tissues, of the tissues to form organs, and of the organs to form systems, supplies the method by which cell work is expressed in bodily action. So perfectly are the cells organized for supplying the various demands made upon them, that we often fail to realize that back of the activity of every organ and system is the activity of cells. In a somewhat similar manner, cell conditions are expressed in the various states of bodily welfare, generally referred to as the health. In so far as the cells are normal and carry on their work in a proper manner, we have good health; in so far as they depart from this condition, we are sick. *Health and disease are both conditions of the cells.* To control health, we must be able to influence the state of our cells. One means of doing this is afforded by the dependence of the cells upon their surroundings in the body.

**Cell Needs.** — Life and health depend directly upon the performance by the cells of four essential processes, as follows:

1. A *taking in* process, called *absorption.* Food materials (protein, fat, sugar, and mineral salts), oxygen, and water are the essential substances absorbed by the cells.

2. An *adding to* process, called *assimilation.* The absorbed material is distributed through the cell, some of it being added to the protoplasm, enabling it to grow.

3. A *using up* process, a phase of which is called *oxidation.* Oxidation is the uniting of oxygen with the food materials and the protoplasm. It is the means of supplying energy and of changing harmful into harmless wastes.

4. A *throwing off* process, called *excretion.* The purpose of excretion is to get rid of materials no longer of

use in the cells and which, if allowed to accumulate, do harm.

To keep up these processes a constant supply of food, oxygen, and water must be available to the cells, and the waste which they excrete must be constantly removed. This requires:

1. The presence in the body of two liquids — the blood and the lymph.[1] The blood occupies a system of closed tubes, the blood vessels, in which it is kept circulating throughout the body. The lymph occupies minute spaces in the intercellular material where it comes in direct contact with the cells and flows through a system of tubes, the lymphatic vessels, which return it to the blood.

2. Organs, called vital organs, which keep the blood and the lymph in a proper condition for supplying the needs of the cells.

3. Such activities of external organs as enable the needed materials to be taken from, and the wastes discharged into, the surroundings of the body.

**How the Blood and the Lymph Provide for the Cells.** — Through the blood and the lymph is solved the great problem of getting materials to and from the cells. Occupying fixed positions in the tissues, the cells are unable to transport themselves to the sources of their food, oxygen, and water, or to get away from the harmful wastes which they throw off. By the movements of the blood and the lymph, the cells are put into communication with their sources of supply and the avenues through which their wastes are removed. Oxygen entering the body at the lungs, and food and water entering from the digestive organs, are received by the blood and carried to all parts of the body. At the capillaries, the smallest divisions of the blood vessels, the materials leave the blood and, passing through the lymph, enter the cells. Wastes, on the other hand, pass from the cells into the lymph and then into the blood. They are then carried by the blood to the various organs by which they are removed from the body (Fig. 1). The lymph, in other words, supplies the immediate environment of the cells, while the blood is a means of keeping this environment in a proper condition.

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[1] The presence of the two body fluids is shown by the minor accidents to which we are prone. If the blood vessels are cut or broken, a red liquid, the blood, escapes. If there is a separation of the layers of the cuticle, such as occurs from a burn or from friction, a clear liquid collects in the small pocket thus formed. The contents of this so-called water blister is lymph.

Recently experiments have been successfully performed of causing animal tissues to live for a month or longer after their complete removal from the body. The success of such experiments depends upon the excised parts being kept in fluids having the essential properties of the blood and the lymph.

**Cells and the Vital Organs.** — There are certain organs (the heart, lungs, liver, kidneys, and the main divisions of the food canal) whose work appears to have a direct relation to the maintenance of life. If any one of these organs becomes so disabled that it can no longer perform its work, life ceases. The dependence of life upon these organs is explained by the close relation which their work bears, through the lymph and the blood, to the welfare of the cells. The heart keeps the blood in circulation, thereby enabling it to act as a carrier for the cells. The lungs supply the blood with oxygen to be turned over to the cells and receive from the blood the gaseous waste, carbon dioxide, which the cells throw off. The kidneys and the liver remove waste from the blood, while the stomach and the intestines keep the blood charged with food and water which are to nourish the cells. The vital organs, therefore, keep up life by ministering to the needs of the cells.

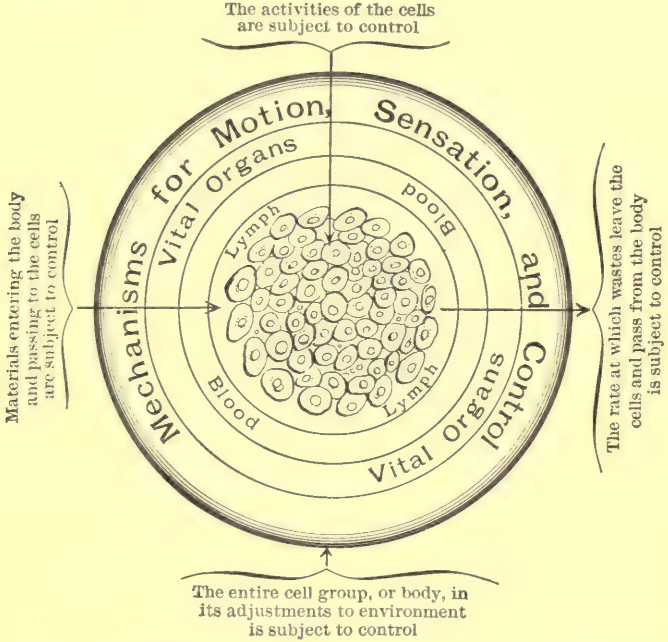
The activities of the cells are subject to control
Mechanisms for Motion, Sensation, and Control
Vital Organs
Vital Organs
Blood
Blood
Lymph
Lymph
Materials entering the body and passing to the cells are subject to control
The rate at which wastes leave the cells and pass from the body is subject to control
The entire cell group, or body, in its adjustments to environment is subject to control

Fig. 1. — **Diagrammatic Representation** of the general fact that health, "a condition of the cells," is a controllable condition.

**Health Control through Control of Cell Environment.** — A little study will show that the general condition of the blood and the lymph depends not only upon the vital organs, but also upon the acts and habits of the individual. It is possible for one to pollute these liquids, or by care and the exercise of good judgment to keep them in a proper condition for ministering to the needs of the cells. What one eats, drinks, and breathes goes into the blood, while the efficiency of the vital organs depends largely upon the habits and the general mode of life. It thus happens that the conditions under which one lives, the climatic, social, and other influences to which he subjects himself, and in general the kind of life he leads, are reflected in the fluids which supply the environment of the cells. By controlling cell environment, we control largely the health of the cells and, through this means, the health of the body as a whole.

**Adjustment to External Environment.** — A second means of influencing cell conditions is found in the relationship which must be maintained between the entire cell group, or body, and its surroundings.

Materials for the cells must come from the body surroundings and upon these the cells also depend for the final disposition of their wastes. But while the body environment supplies conditions beneficial to the cells, it also contains agencies that injure and that may destroy the entire cell group or body. From violent storms, from the extremes of heat and cold, and from adverse conditions generally, some means of protection must be found. In short, the body must be brought into such relations with its surroundings as will satisfy its needs and avoid the agencies that would injure or destroy it. This is essentially a problem of adjustment — the means for which are found in the body itself.

**External Organs the Instruments of Adjustment.** — While the conditions for cell life are supplied through internal (vital) organs operating upon the blood and the lymph, the body as a whole is adjusted to its surroundings by external organs. The feet and the legs move it from place to place, and the eyes direct these and other movements. With the hands for grasping and the arms for extending and withdrawing these grasping organs, the body is equipped with the necessary instruments for moving materials about and for making such dispositions of them as best suits its needs. Shelter is provided, clothing manufactured, and the other necessities of life secured. The problem of external adjustment, moreover, has always been attended with great difficulties. Only by hardship, "by the sweat of his brow," has man succeeded in subduing nature and in developing an environment adapted to his needs.

**Adjustment to Social Environment.** — But man is not only an animal; he is a social being as well. Each individual is a part of that great human organization, called society, and to society his relations are fully as vital as to his physical environment. He has to learn the principle of coöperation — the working together for mutual benefit. He must relate his life to the lives of others and fit himself into the minor organizations through which the work of civilized life is carried on. In other words, *he must adjust himself socially.* In social adjustments the organs of speech and hearing play a most important rôle. They supply a necessary means of communication between people, making possible the exchange of ideas through speech.

**Adjustment and the Nervous System.** — The most essential factor in bringing about physical and social adjustments and of controlling the body generally is the nervous system. On the one hand, the nervous system is sensitive both to environment and to the internal bodily condition, and on the other hand, it governs all phases of bodily activity. Through the brain it provides for intelligence, or mind, and through a system of nerves connecting the brain with the eyes, ears, and other organs of sense, the mind is placed in communication with the outside world. Another system of nerves connects the brain with the muscles, and through these the mind is able to excite such movements as the external conditions or the bodily needs require.

The nervous system also provides for adjustments that take place reflexively, that is, independently of the mind. In this way it controls the vital organs and regulates conditions affecting the cells. Through these various ways the nervous system is most intimately related to general bodily welfare. Good health is impossible if the cells of the nervous system are impaired or exhausted.

**Health Control through Adjustment.** — Adjustment is perhaps the broadest of the health principles. The maintenance of good health "depends upon keeping the body in a condition of physiological harmony with the various agencies that affect it," and this means that adjustments of one kind or another must be made continually. These include such changes in the environment as adapt it to the needs of the body and such changes in the position, condition, or activity of the body as enable it to use material surroundings to the best advantage. Proper physical and social adjustments make for good health; improper ones make for ill health. On account of the important rôle of the nervous system in securing adjustments, its special hygiene bears directly upon the general problem of health control.

**Generation and Expenditure of Bodily Energy.** — Still another means of influencing cell conditions is found in our methods of using bodily energy, or power. Our energy is derived from different kinds of foods and from the oxygen which we breathe. These contain energy in the potential or latent form, somewhat as energy is associated with the water in a pond above a mill dam or is resident in gunpowder or dynamite. This energy becomes available for the use of the body through chemical processes that take place in the cells. The oxygen unites with the elements contained in the food, and, in so doing, transforms the potential energy into kinetic, or active, energy which is then expended in body work.

**Energy Outlets.** — The body expends energy both internally and externally. In the circulation of the blood, the digestion of the food, breathing, and the throwing off of waste, energy is spent on the inside and in ways that directly pertain to the welfare of the cells. In moving the body from place to place, in procuring food, clothing, and shelter, and in bodily adjustments generally, energy is expended through external channels. One outlet for energy is through the muscles, another is through the brain, and a third is through the organs (glands) that manufacture special substances needed in the body. Something like four-fifths of the body's energy is expended as heat.

**Health through Energy Control.** — Certain facts relating to the expenditure of energy by machines are applicable to the energy problem of the body. We cannot expend more energy than we generate, and energy used for one purpose cannot be used for another. In the distribution of electrical energy the switchboard is all-important because it determines the lines along which the current shall expend its power. Corresponding to the electrical switchboard is the human brain. It is a function of the mind to determine in what manner and to what extent the bodily energy is to be expended.

While the energy spent upon the vital processes is not subject to mental control, we can nevertheless throw so much energy into our external activities, that an insufficient amount remains for the activities of the vital organs. The result is the reduction of the sum total of the energy produced, and from this reduction the whole body suffers. In the human mechanism, as in the steam engine or the automobile, the conditions having to do with the generation and the use of energy have much to do with its efficiency and the length of time that it will last.

**Energy Control and Cell Vigor.** — In the control of the expenditure of energy we have a means of controlling even the vigor, or efficiency, of the bodily cells. This is through the well-known principle of exercise. Energy expenditures exercise the cells and this exercise, within certain limits, renders them more efficient in their general and special work. Nor is this effect limited to the cells directly concerned, but it extends to all those cells upon which the active ones are in any way dependent. Muscular work, for example, brings into play the controlling nerve cells and the cells of all the vital organs, as well as the muscle cells (Chapter IV). To invigorate bodily cells is to improve the very source of health.

**What Health Control is Like.** — Health control being similar in some of its phases to the controls which people are constantly exercising, the student may gain some insight into the process from comparisons. As a gardener controls the growth of his plants by supplying the conditions — soil fertility, moisture, etc., — which enable the plants to thrive, so may we supply in the cell environment, the conditions necessary to bodily health and vigor. As the sea captain, through the agency of rudder, sails, and the engine, finally brings his vessel to its destination, we may through the expenditure of energy and the exercise of mind, so manage the whole cell group, or body, that it avoids harmful agencies and attains its essential purposes. And as horses are brought under control through bit and line, so may we through energy of will, or determination, subdue instincts and passions that are detrimental.

Although health control comprehends much more than is included in any kind of control that is exercised by man, it is similar to such controls in that definite means are applied to the production of definite ends and purposes.

**Control through Obedience.** — That *every effect has its cause*, and *without cause nothing takes place*, is a fundamental principle of science. It is this principle which must be applied in the general scheme for controlling health. There are methods of living which are in entire harmony with the nature and plan of the body, and there are methods of living which are antagonistic to it. To follow the first and avoid the second requires knowledge, and it also requires an attitude of mind prepared to put that knowledge into practice. To secure health we must observe the conditions upon which health depends. The statement of Lyell, while true as a general fact, is especially true in matters pertaining to health. "*We can command Nature only as we obey her laws.*"

**Summary.** – Back of the activity of every organ and part of the body are the activities of the cells, and from the sum total of such activities results the general condition known as health. Health is good or bad according to the general state and vigor of the cells and is controlled through the means by which the cell needs are supplied. While cell health depends directly upon the blood and the lymph, it depends remotely upon the substances taken into the body, the efficiency of the vital organs, the adjustment of the body to its surroundings, and the generation and expenditure of bodily energy. Since we can determine what substances shall enter the body, govern to some extent the efficiency of the vital organs, determine our adjustments to environment, and regulate the expenditure of our energy, we can control to a very large degree cell conditions (Fig. 1), and through these, our health.

**Exercises.** — 1. Name the parts of the typical cell. Describe the conditions surrounding the cells of the body.

2. Explain the general plan of organization through which cell work is expressed in the action of organs and systems.

3. Define health. State what is meant by "good health" and "poor health" from the standpoint of cells?

4. Show that it is possible to keep an organ or a tissue alive which is entirely separated from the body. Does the process differ essentially from that of keeping alive the body cells?

5. How can the composition of the blood and the lymph be changed by our foods? By the air we breathe?

6. Why are the vital organs so called? Name and give the special work of each.

7. Show that the work of some vital organ, as the stomach, may be influenced by our habits of living.

8. What constitutes the body's environment? Show that the bodily adjustment is a double process — involving both the body and its environment.

9. What daily adjustments to temperature are necessary to good health?

10. Explain the relation of the nervous system to the work of adjustment. How do reflex adjustments differ from voluntary adjustments?

11. What are social adjustments? What is their purpose and why are they important?

12. Name the kinds of bodily energy. Show that health control depends upon energy control.

13. In what respect is controlling health like controlling the growth of plants? How like controlling a ship at sea? How like controlling a fractious horse?

14. Summarize the general facts in the plan of the body that supply a basis for control.

## Health Work

It is of little value to study the means through which health is to be controlled, unless this knowledge is put into practice. Every boy and every girl, as well as every grown person, is daily confronted with the problem of keeping well and should, for this reason, be especially interested in the practical application of health principles. Health work embodies two kinds of effort — that of supplying the general conditions upon which health depends and that of adapting general principles to individual needs. The following health rules, based in part upon the experience of people and in part upon facts brought out in the present chapter, have reference to general conditions:

**General Rules of Health.** — 1. One should sit and stand erect and in all other respects preserve the natural form of the body.

2. There should be sufficient physical exercise each day to keep up the general tone or vigor of the entire muscular system. For the average person this is not less than two hours.

3. Living rooms, work-rooms, and bed-rooms should be well ventilated, and as much time as possible each day should be spent out of doors.

4. The body should be given a necessary protection against cold and exposure, but overprotection should be avoided.

5. Food must be supplied in sufficient variety to meet bodily needs, and the quantity varied according to the activity. One should avoid overeating and eating between meals. Thorough mastication should be practiced and the mouth kept clean and wholesome. From one to three pints of water should be taken daily between meals, in addition to the rather free use of water during meals. Stimulating drinks should be avoided, as well as drinks that are very hot or very cold.

6. The organs of elimination should be active, and especially should there be a free movement of the bowels each day.

7. Nervous energy should be used for its intended purpose and not wasted.

8. The body and its immediate environment should be kept clean.

9. All the avenues through which the germs of disease are liable to attack the body should be carefully guarded.

10. In one's relations with other people he should be agreeable and courteous, avoiding unnecessary conflict and strife.

11. Each individual should coöperate with his fellows for the establishment of general conditions conducive to health.

It is recommended that each pupil put into practice as far as he is able these general rules of health. In the chapters following, numerous ways are suggested by which these are adapted to individual needs.

# CHAPTER III

## VARIATIONS IN PHYSICAL CONDITION: THEIR CAUSES AND THE GENERAL METHOD OF THEIR CONTROL

FEW indeed are the people who enjoy perfect health. Even among those supposed to have good health there are wide variations of physical condition. Slight departures from recognized standards of health are referred to as indispositions and weaknesses, while serious departures are classed as disease. A study of the variations in physical condition, especially as they may occur in the same individual, will throw much light upon the general problem of health control.

**Indications of Ideal Health.** — As students of hygiene we need to get clear and well-defined ideas of what constitutes ideal health, or bodily condition which is in all respects normal. The chief characteristics of this state are as follows:

1. The skin is clear, smooth, soft, and rather moist, and the face and hands (of the Anglo-Saxon and Teutonic races) have a light pinkish or ruddy color. The well person perspires freely and the perspiration may or may not have perceptible odor.

2. The eyes are bright and clear, and the eyelids are without scales, styes, or congestions of any kind. The eyeballs are rather soft and springy to the touch and are not sensitive to slight pressure. The eyes may be used on close work for rather long periods of time without

pain or irritation and without causing headache or nervousness.

3. The thoroughly well person sleeps soundly, feels well, is cheerful and buoyant, and is free from aches and pains. He is optimistic and does not worry.

4. The food digests easily and no irritation is felt in the stomach and intestines following meals. The breath is without odor and the tongue is perfectly clean and of a deep red color. The bowels move freely at least once a day, the feces being relatively soft and the evacuations occurring without special effort or strain.

5. Nose breathing is free and natural, there being no obstruction from adenoids, nasal polypi, or projecting bones. The tonsils are normal in size, and are not inflamed, and there is no catarrh of the nose, throat, or other mucous surfaces. The breathing capacity should be at least 250 cubic inches for the adult male and 150 cubic inches for the adult female, and the lung surfaces should be sound throughout.

6. The entire body is well-formed and symmetrical. The chest is full and rather protruding, the shoulders square or slightly rounded, and the neck and the spine maintain an erect position without special effort. The waist is but slightly less in girth than the lower part of the chest, and in the average normal woman is 29 inches.[1]

7. The muscles of the arms and legs are well developed, but may or may not be hard and strong. The muscles of the neck, back, and the abdomen are well developed and vigorous. A considerable amount of muscular work does not cause undue fatigue. The weight corresponds to the height (the average male of 6 feet weighs 175 lbs.

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[1] Galbraith, *Personal Hygiene for Women.*

and the average female of $5\frac{1}{2}$ feet weighs 143 lbs.), and one in health is neither unduly thin nor unduly stout.

8. The circulation is vigorous and equally distributed. The hands and the feet keep comfortably warm and there are no congestions of mucous surfaces. The skin is well flushed with blood, and because of this fact one does not under ordinary conditions experience chilly sensations. The pulse is regular and not far from 70 per minute, while the blood pressure is not usually more than 110 millimeters for those under 25 years of age.

9. The bladder requires emptying three or four times a day, but the perfectly well person does not rise at night for this purpose. The liver, heart, lungs, and other organs perform their work without pain or distress of any kind.

10. The health of the normally well person is on a natural basis. He has no need for drugs, stimulants, or medicines, either to make him feel well or to increase the activity of any of his organs.

**Health Differences among People.** — According to their states of health, people may be temporarily classified in the following groups:

1. Those whose physical condition corresponds to the ideal of health as stated above. This class is relatively quite small — much smaller than it should be.

2. Those in a fairly vigorous condition. This class includes most of the world's efficient workers. They are able to perform the duties devolving upon them and they seldom complain from fatigue and overwork, but are less efficient than they would be with perfect health.

3. Those lacking in energy, vim, and enthusiasm, but able by extra effort to perform life's duties with a moderate degree of success.

4. The semi-invalid class. The members of this class are usually up and about, but are easily fatigued and succumb readily to overwork and exposure. Their health is a constant source of concern.

5. Invalids or sick people. One may be said to be sick when he has little or no energy for external work, but must use most of it for the internal work of the body. Hence the best place for the invalid is usually in bed, and to make a successful fight in winning back his health, he should have the care and advice of a competent physician.

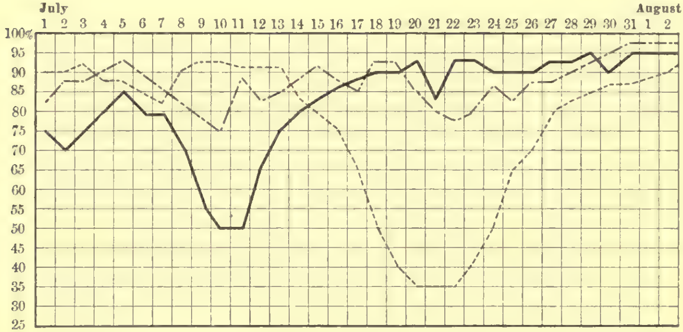

FIG. 2. **Health Variations of Three Students.** — Curves plotted from daily health grades given for a period of one month. The steady upward trend toward the close of the month indicates improved ability to control the variations.

**Health Variations in the Same Person.** — To attempt any permanent classification of people according to the above scheme would be impractical and for the reason that the health of any individual is a highly variable condition. One with a low degree of health, or even with some disease, may quickly improve, and one in perfect health may as quickly descend into invalidism

(Fig. 2). No physical state can be looked upon as constant from day to day. Only the variations are continuous, and while these may be slight, everyone may regard himself as either improving or declining in health during even the shortest period of time.

Both to avoid temporary inconvenience and to attain the highest degree of health of which we are capable, it is necessary to acquaint ourselves with the causes of these variations. All such causes tend in their effects either toward or away from those serious declines of health that are known as disease.

**Nature and Kinds of Disease.** — Disease is some abnormal or unnatural condition of the body, of a more or less serious nature, which is characterized by special symptoms. Although such a condition may prevail among all or many of the body cells, it is more frequently confined to the cells of some particular organ. Diseases are classified as organic and functional, and as acute and chronic. In *organic* disease there is actual impairment of the cells forming some organ or part of the body, this being called a lesion. In the *functional* disease of an organ, there is apparently no lesion, but failure, nevertheless, on its part adequately to perform its work.[1] A chief cause of functional disease is weakness of the nervous system — the controlling factor of the body. *Chronic* diseases are those that develop slowly and persist through long periods of time, while *acute* diseases are swift in their development and are of short duration.

From the standpoint of their origin, diseases are further classified as *hereditary*[1] and *acquired*. The first class includes all bodily defects, either organic or functional, with which one is born; the second includes all diseases to which the growing or matured body may be subject. Special interest attaches to acquired diseases from the fact that they are largely preventable.

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[1] One kind of organic disease of the heart is an *insufficiency of the valves*, which permits leakage in the pumping of the blood, and another is fatty degeneration, caused sometimes by the use of alcohol. On the other hand, irregularities in the heart's action — beating too fast, or with insufficient force, or skipping beats — are referred to as functional disorders.

**Causes of Declines in Health and of Disease.** — Prior to the development of medical science, the origin of disease was a mystery and attempts to account for it were usually along the lines of prevailing superstitions. Such theories of the causation of disease as the wickedness and moral transgressions of individuals, the presence in the body of harmful spirits (demons), and the baneful influence of evil-minded persons (witches), have been held in the not very remote past. A favorite superstition, entertained by certain devout people even at the present time, is that disease, as well as health, is among the dispensations of Divine Providence.

Modern medical science teaches that all declines in health, whether they be slight or serious, arise from well-defined *natural* causes and that without these causes they do not occur. Since health is a condition of the cells, the causes of ill-health are to be found in the various influences and conditions that injure the cells or that interfere with their activities (Chapter II). These may be classed, according to the way in which they act, as direct or immediate causes, and as indirect or remote causes.

**Direct Causes of Disease.** — The direct causes of disease include all conditions within the body itself, or upon its exterior surfaces, that interfere in a more or less direct manner with the cells. By recalling the methods by which the cells are supplied with nourishment and relieved of waste, how energy is generated and how it is used by the various organs, and how the nervous system controls and regulates activity, many possibilities of cell interference are suggested. These are best classified under four heads as follows:

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[1] Strictly speaking, no disease in its active stage is inherited. Bodily defects and weaknesses inviting to particular diseases are, however, often transmitted from parents to children.

1. *Cell interference from mechanical causes.* Mechanical conditions that interfere with cell activity present the greatest variety. They include defects of structure that prevent the proper functioning of organs; displacements of organs and tissues that cause irritation or interfere with their work; obstructions in the food canal, air passages, or the outlets to glands; and impediments to the circulation from accumulations of fat and from other causes. Some of these injure the cells by direct impingement, while others do harm by clogging the movement of materials to and from the cells. Often they have the double effect of causing general weakness and of setting up irritations which result in specific diseases.

2. *Cell interference from chemical causes.* These result from the presence in the body of substances which tend to alter the composition of the body fluids or to interfere with their normal reactions. One prolific source of such substances is the improper working up of foods as they are digested and passed to the cells, and another is the lingering of wastes which should be quickly passed from the body. The term *auto-intoxication* is used by physicians to express the poisoning effects of substances produced in the body under abnormal conditions. Chemical interferences also arise from harmful materials in-

troduced through the mouth, such as alcohol, certain drugs, and strong acids and alkalis, and by the injections of poisonous reptiles and insects. A special danger arises from the chemical poisons secreted by the germs of disease. A large class of ailments, known as the diseases of metabolism (page 216), arises chiefly from cell interference through chemical causes.

3. *Cell interference from micro-organisms or germs.* In one way or another, various kinds of micro-organisms, chiefly bacteria, are the means of injuring the body. If they penetrate the outer layer of the skin or find lodging places upon the mucous linings of the nostrils, throat, lungs, digestive tract, or other organs, they live upon the body fluids and reproduce themselves in vast numbers. To some extent they destroy cells, but their greatest harm comes from the chemical poisons, referred to above, which they secrete and which are taken up and distributed by the blood.[1] These are especially injurious to the cells of the nervous system. Diseases caused by micro-organisms are referred to as infectious diseases. All contagious diseases belong to this class.

4. *Cell interference through interference with the nervous system.* Special significance attaches to any kind of injury to the cells of the nervous system. Since these must adjust the body to its environment and control its various activities, the effects of their impairment are serious and far-reaching. Injury to the cells that have to do with hearing or sight, for example, may so interfere with bodily adjustments as to lead to harmful accidents, while a general exhaustion of the nerve cells may lead to

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[1] In many instances germ colonies become established in the nostrils, throat, and other parts of the body which do not result in specific diseases, but which, by lowering the tone of health, render one more liable to all kinds of ailments.

nervous diseases and to imperfect control of the vital organs. The nerve cells may be injured by mechanical obstructions, chemical poisons, shocks of various kinds, overwork, and by other means. Diseases resulting from such injury are of two general kinds — diseases of the nervous system proper, and functional diseases of the bodily organs.

Most important in this connection is the fact, now thoroughly established, that bodily conditions which act as causes of disease can be altered and in many instances entirely removed. The attainment of such a result is often the first step toward securing control of the health.

**Indirect Causes of Disease.** —Under this head may be grouped such conditions and influences as indirectly and remotely interfere with the cells. They produce their effects by leading up to some one or more of the direct causes or by aiding these in their action. For example, the accumulation of waste is a direct cause of the diseases of metabolism, but the kind and amount of food eaten, the exercise taken, and the general mode of life determine whether or not the wastes accumulate. These latter are classed as indirect causes. Again, the direct cause of tuberculosis is an established colony of germs (*bacilli tuberculosis*) within the body. Indirect causes of tuberculosis are found in the agencies that favor the passage of germs from the sick to the well and in influences that reduce the physical vigor of those contracting the disease.

The indirect causes of disease are abundant and are of great variety. Anything, in fact, which is capable of affecting living matter may become the means of lowering the tone of health. Severe climatic conditions, agencies that favor the development and propagation of disease germs, nervous irritations, habits of a detrimental nature, methods of using the body that impoverish or exhaust the cells, and failure to supply conditions under which the body works to best advantage, are among the more potent of the indirect causes. It is a fact, moreover, that many of these act in such a manner that we may be entirely unconscious of their presence.

**How Indirect Causes are Overlooked.** — Where the relationship of the cause to the effect is close, as in the results that follow exposure to extremes of heat or cold, we soon learn by experience what to do and what to avoid. But many of the causes that injure the health must act through long periods of time before perceptible effects are produced,[1] and some will act differently upon different individuals, having apparently no effect upon a few. Other causes are so insidious in their action that they are concealed both to the eye of sense and of the mind, and one without special training has no means of detecting them. These general facts account largely for the failure of people to control their health and for the superstitious awe with which they have regarded disease.

Experts and specialists, however, have been at work in the field of indirect causes, and science has revealed much which was previously hidden. This new knowledge supplies the basis for the modern assumptions that *disease is preventable* and that *health is subject to control.*

**The General Method of Control.** — The facts set forth in the preceding pages show that health is a resultant of various forces, acting both within the body and from the outside, which may be grouped into two opposing classes

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[1] As the constant dropping of water wears away the hardest stone, so do apparently insignificant causes, by acting through long periods of time, produce profound effects upon the health. This fact should engage the most serious attention of the hygienist. Many of the causes that affect the health act through long periods.

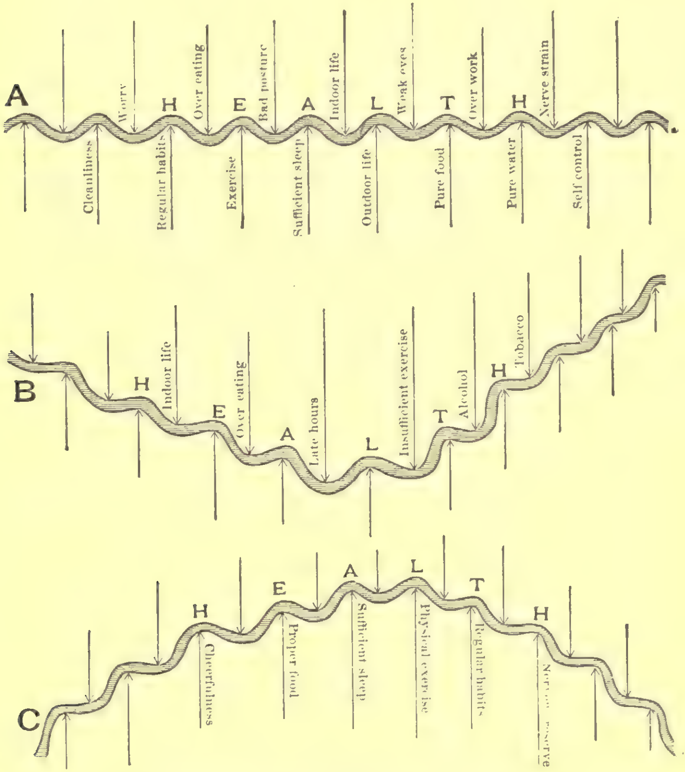

FIG. 3. — **Health a Resultant of Opposing Forces.** In diagram *A* the upward and downward forces are supposed to be equal. In *B* the downward forces exceed the upward forces, causing a decline in health. In *C* the upward forces exceed the downward forces, causing the health to improve.

— those that improve the health and those that make for disease (Fig. 3). It follows, therefore, that to control health we must so manipulate the forces which determine the physical well-being as to secure the state which is desired. If we would improve the health, we must withdraw or lessen the forces that make for disease and secure a fuller action of those that make for good health. That this method is effective has been fully demonstrated. That it may be applied both by the individual and by individuals working in groups is shown by the illustrations which follow.

**Health Control in Individual Cases.** — When one is sick he sends for a physician, who, on diagnosing his ailment, prescribes treatment. The physician's plan may be to remove or counteract existing causes of disease, to render active some latent force of health, or to accomplish both purposes. If a sufficient alteration is effected in the forces acting upon the patient, he begins at once to improve. The method is still simpler when disease is not yet established, but there is only a low state of health. The following typical cases will illustrate controls of this kind:

*A*, a capable and conscientious bookkeeper, who found his health running down, made note of the fact that he was taking little exercise. He changed his habits, enrolling in a local gymnasium club and walking to and from his work instead of taking the street cars. As a result his health began to improve as did also his efficiency.

*B*, a college graduate, found himself at the age of thirty-five on the verge of nervous prostration, supposedly on account of his heavy work as a teacher. His nervous trouble, however, was found to be due to eyestrain. With a good fitting of glasses and with the exercise of greater care in the use of his eyes, his nervous system became entirely normal.

*C*, a merchant, found that the confinement of his store made him dull, cross, and listless. Following the advice of his physician, he made some changes in his diet and allowed himself more time out of doors. As a result of these changes, life in the store lost most of its disagreeable features.

The point to be noted in all these cases is that the desired effect was secured through the manipulation of causes. Exactly the same method is followed in controlling the health of communities and of bodies of workmen.

**Health Control and the Panama Canal.** — Until quite recently the tropical countries have been looked upon as plague spots, dreaded and avoided by white men generally. The efficient health work which has been carried on in conjunction with the construction of the Panama Canal has, however, demonstrated the possibility of so changing prevailing conditions that the problem of keeping well in the tropics is no greater than in other parts of the globe. Prior to the construction of the canal, the discovery had been made that the two worst disorders (yellow fever and malaria) of hot, sultry climates were caused by germs whose spread was dependent upon mosquitoes. Certain kinds of mosquitoes (page 348) by biting those sick with these diseases, first infected their own bodies. Later by biting those who were well, they communicated the germs to new victims. This knowledge supplied the basis for effective work in the prevention of both diseases.

Under the direction of an expert sanitary engineer, Dr. W. C. Gorgas, a vigorous warfare was waged against mosquitoes. By interfering with the propagation of mosquitoes by every possible means (page 349), and by the screening of public and private buildings to prevent both the sick and the well from being bitten, an essential cause in the spread of yellow fever and malaria was removed. Other measures were employed for the prevention of minor diseases, and as a result of all these efforts the thousands of men engaged upon the canal were kept in a proper physical condition for work. Indeed, if we compare the experience of the Americans with that of the French a few years earlier in the same enterprise,[1] we must conclude that health control made possible the construction of the great canal.

**Automatic or Instinctive Control.** — In the conscious application of health principles, the fact must not be overlooked that the animal body has its own system of control. Through a nicely adjusted nervous mechanism we are automatically guided in what we should and should not do. Pains warn us when bodily structures are being injured, hunger makes us diligent in supplying food, chilliness causes us to provide the means of warmth, and if we are injured through disease or other causes, our very weakness compels us to diminish our activities. The various habits which we form soon become a part of the automatic system and, when these habits are of the right kind, they greatly improve its efficiency. So perfect in some instances is this method of control, that people have lived in good health and vigor to advanced years without conscious effort to regulate or direct their physical well-being. It is evident, therefore, that we should not interfere with this valuable system or diminish the range of its influence.

**The Sphere of Conscious Control.** — If one attempts to control his health to the extent that he becomes unduly concerned — thinks constantly about himself and even worries about his condition — he is likely to impair rather than to improve his health. This is because the conscious system which he is attempting to operate is less effective than the automatic system which he is in part displacing. On the other hand, if he depends upon his automatic system to the extent to which it is adequate and sufficient, and attempts conscious control only to the extent in which it fails to satisfy recognized bodily needs, he experiences beneficial results. That the automatic mechanism of control requires considerable supplementing and some correcting, however, is evidenced by three facts:

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[1] During the first attempt of the French to construct the canal (1882–1890), the average annual death rate among employees was reported at 231 per thousand. (It was not then known that fevers were spread by mosquitoes.) The average annual death rate among the Americans has been only 17 per thousand. The deaths from malaria were reduced from 87.9 per 10,000 in 1906 to 9.6 per 10,000 in 1911. There was no case of yellow fever in the six years from 1906 to 1911.

*First*, the promptings of the automatic system are in many instances misleading. They are especially misleading if one has become the victim of pernicious habits (pp. 155–157).

*Second*, the bodies of vast numbers of people do not conform to the normal type.

*Third*, the environment to which people are subjected fails in numerous respects to harmonize with the automatic controlling mechanism.

The last two of these facts require some explanation.

**Departures from the Normal Type.** — To the extent that one falls short of the ideal of health described at the beginning of this chapter, do internal conditions arise that interfere with the natural operation of the body. Bodily weaknesses, whether they be inherited or acquired, call for special adjustments and adaptations that are not provided for instinctively, and these must be supplied through conscious effort. For example, one whose vitality is being impaired through chemical causes cannot blindly follow the instinctive method of eating and maintain even the degree of health which he possesses. He must follow the special course which science has marked out for such cases. Each weakness adds, moreover, a problem of health — a condition which requires conscious bodily direction both for the maintenance of health on its present basis and for the removal of a cause for conditions that may be worse.

**Defective Environment.** — While environment is a factor in everything pertaining to human welfare, it is most potent in its influence upon the health. The automatic mechanism of control responds readily to surroundings similar to those under which the race developed, but is not adapted to many of the artificial conditions supplied by modern life. The result is a partial misfitting of the natural body to the surroundings under which most people live and work. To the extent that the environment fails to supply the material needs of the body or to exact from it the activities that make for health and vigor, does it become defective, or disease producing and one exposed to such an environment cannot follow entirely his natural bent. If he would keep well he must consciously overcome the environmental influence, and this he can do either by counteracting or by supplementing its defects.

**Health Diagnosis.** — Before the physician prescribes treatment he carefully studies the condition of his patient and arrives at a conclusion regarding the nature of the ailment and the causes upon which it depends. This examination, together with the conclusion reached, is termed the diagnosis. A somewhat similar investigation of the bodily welfare must frequently be made if one would apply the principles of health control with any degree of accuracy. This, however, should not be limited to bodily conditions, but should include habits, the general mode of life, and the environment. Answers to such questions as the following are especially desirable:

What are the bodily weaknesses that require correction? To what extent do occupation and the home life fail to supply all the conditions necessary to good health? What are the mild agencies which, though producing little effect from day to day, will, if permitted to act through long periods, profoundly affect the health? Upon the information supplied by such a study may be laid out a daily régime of health work, partly corrective and partly preventive, whose purpose is to maintain a vigorous bodily condition and to avoid disease.

**Summary.** — Great variations are to be found in the physical condition or health, and these are manifest both when we compare people and when we observe the same individual from day to day. Although these differences are in part hereditary, they are in large measure the results of widely prevalent and constantly acting causes. In the daily routine of activities, in the ebb and flow of life itself, are conditions and influences that are affecting the body for good or for ill — good in so far as they are in harmony with the nature and plan of the body; ill to the extent that they are out of harmony.

All methods for controlling health involve the manipulation of these causes. Withdraw the causes of disease and make more positive the causes of health, and the physical condition improves. If we consciously or unconsciously permit the opposite causes to act, the health declines. Bodily weaknesses and differences in environment are factors, however, that render the problem of health control vastly more difficult for some than for others. While a few fortunate individuals are able to keep well through the method of instinctive living, the majority must supplement to a considerable extent their automatic mechanism of control.

**Exercises.** — 1. Describe an ideal state of health. What are some of the simple causes for health variations in the same person?

2. Define disease. How do organic differ from functional diseases? Acute from chronic?

3. What is the general method through which all causes act in the production of disease? How do the direct differ from the indirect couses?

4. Explain the nature and method of action of the mechanical causes of disease. Of the chemical causes.

5. In what different ways do bacteria injure the body? By what means are germ diseases contagious?

6. How does injury to the nervous system cause functional diseases of bodily organs?

7. Explain the nature and importance of the indirect causes of disease. How are they frequently overlooked?

8. State the general plan by which the health is controlled.

9. Explain the method by which the physician improves the health of his patient.

10. Mention several illustrations of health control by the individual.

11. Describe the method of controlling the health of workmen during the construction of the Panama Canal.

12. Explain the instinctive method of control. Why should we depend mainly upon this? What methods of conscious control are liable to interfere with it?

13. Why is health control more difficult for some than for others?

14. Define environment. In what respects is our automatic mechanism for controlling health dependent upon environment? When does environment become defective?

15. In what respects may the school-room environment be defective? How is possible injury from this cause to be avoided?

16. What facts must be known before one can apply intelligently a system of health control?

### Health Work

The present chapter brings out the fact that bodily defects and weaknesses, in addition to impairing efficiency, are constantly acting causes of still worse conditions and even of disease. Obviously such conditions should be remedied as soon as possible, whether the appropriate remedy be hygienic or medical. In all cases where they can be remedied through hygienic means, the task of self-improvement should be undertaken as soon as possible. As an aid in such work the pupil should, with the assistance of the hygiene teacher, the gymnasium director, or a physician, prepare a personal record as suggested by the outline below and file the same for future reference and study.

### *Health Record Outline*

1. *Name.* — .......................... Address..................
2. *General facts.* — Age...... Height...... Weight...... General condition (whether thin or inclined to be stout)...... Childhood in country, village, or city...... Have you had diphtheria?...... scarlet fever?...... tonsilitis?...... typhoid fever?...... appendicitis?................ What surgical operations, if any, have you undergone?.............................................
   What serious accidents have you suffered?.......................
   Are you now receiving any kind of medical treatment?.... .....
3. *Drugs and stimulants.*— Do you use tobacco?...... tea?...... coffee? ...... or any other drug or stimulant?...... Is it frequently necessary for you to take medicine?...............................
4. *Activities.*— Hours of mental work...... Time given daily to physical work or exercise...... Kinds of exercise taken...................
   Time of retiring at night.......... Of rising.......... How much, if any, do you sleep in the daytime?..........................
5. *Muscles and skeleton.*— Are the muscles hard or soft?...... Are you easily fatigued?...... Can you do a full day's muscular work without bad effects?...... Grip test...... Do you sit and stand erect *naturally* or are you inclined to stoop?........ Girth of biceps (relaxed) ..... (contracted).......... Girth of neck..........Is the chest flat or protruding?.......... Are the shoulders round or square? .......... Are they of the same height?...... Condition of the spine...................................................
6. *Feet and ankles.*— Is there tenderness or weakness in the ankle or the instep?..... Do you wear shoes with high heels and narrow toes or the reverse?.............. Are you troubled with corns, calloused places or ingrowing nails?...... Does the weight fall squarely upon the feet or somewhat upon their sides? ........................
   Are the toes in their normal positions or are they crowded together? ............................. Are the ankles straight or is there an inward or an outward sag? ..............................
7. *Nervous system.*— Are you inclined to be nervous?......Do you sleep well?...... Do you worry?...... Have you headaches or neuralgia? ...... How frequently?...... Do you talk rapidly or slowly?......

Are you inclined to be peevish and irritable or are you *naturally* good natured and cheerful? ........................................
Are you easily excited?...... How frequently do you have the blues?................................................

8. *Eyes.*— Condition of the lids (are they inflamed and do they itch or smart from close work)?...... Do the eyes hurt from study or reading?..... Does the use of the eyes make you nervous, cause headache, or interfere with your ability to sleep?...... Are the eyeballs hard to the touch or are they somewhat soft and springy? ............ Are you subject to styes?...... Do small scales form around the eyelashes?...... Does bright sunlight, electric light, or moving pictures hurt the eyes?...... Have you ever worn glasses?...... What previous eye troubles, if any, have you had?...... Acuteness of vision of *R. E.*...... *L. E.*...... (expressed by a fraction in which the distance from the chart is the numerator and the number of the line read the denominator). Astigmatism, *R. E.*....... *L. E.*....... (yes or no). Muscle imbalance, horizontal........vertical......... (yes or no). (For method of making simple eye tests, see Health Work section, pages 273–275.)
9. *Ears.*— Acuteness of hearing of right ear...... left ear...... (distance in feet which a watch tick can be heard). Is there frequent earache?....... Do colds affect the ears or hearing?..............
10. *Circulation.*— Pulse rate (beats per minute)...... regular or irregular...... Blood pressure (measured with sphygmomanometer, page 225)...... Is skin circulation good (skin well flushed with blood)? ...... Are you troubled with cold hands and feet?...... Does this condition become worse from study?...... Do you take cold easily? ...... Mention any troubles of the heart or blood vessels which you have had?................................................
Heart sounds or murmurs (stethoscope test)........................
11. *Digestion.*— Does food digest easily or with difficulty?..............
Is the appetite strong or weak?....... Is the tongue usually coated or clean? ......... Is there frequently a bad taste in the mouth? ......Is there much belching of gas?...... Are there pains or burning sensations in the region of the stomach or abdomen?...... Name the protein foods (page 119) upon which you commonly depend?....................................................
How often do you eat meat?..................................
Do you use much or little fruit?................ Do you use much or little sugar, including candy?................ How many meals a day?........ Do you masticate thoroughly and eat slowly, or the reverse?..............................................
12. *Teeth.*— General condition............ Are they regular or irregular? ............How many and what ones are missing?..............
Number needing filling...... Frequency of toothache...........
of neuralgia............... Name any trouble with the gums or with the roots of teeth....................................

Give method and frequency of cleaning the teeth and the mouth
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

13. *Lungs and air passages.*— Is nose breathing free and natural? . . . . . . .
Is there nasal catarrh? . . . . . . . . . . Frequent sore throat? . . . . . . . . .
. . . . . . . . . . . . Is the diaphragm used in breathing? . . . . . . Do colds attack the lungs? . . . . . . Breathing capacity (in cubic inches) . . . . . .
How much time is spent each day out of doors? . . . . . . . . . . . . . . . . . .
State the usual temperature of bed-room . . . . . . . . . . Give method of ventilating bed-room . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
Do you consider yourself liable in any degree to lung troubles? . . . . .

14. *Elimination.*— Is the skin clear or sallow? . . . . . . . . Dry or moist? . . . . . .
Do you perspire freely . . . . . . Are there any skin eruptions? . . . . . .
Do the bowels move freely each day or is there constipation? . . . . . . . .
Name any disease of the kidneys or liver you have had or now have
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
Are there rheumatic pains? . . . . . . In what parts of the body? . . . . . . . .
Is there swelling of the feet from standing? . . . . . . . . . . . . . . . . . . . .

15. *Health problems.*— *a.* Make a list of the bodily conditions which you desire to improve through hygienic means . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
*b.* State what hygienic measures you employ in order to offset the weakening effects of school work . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

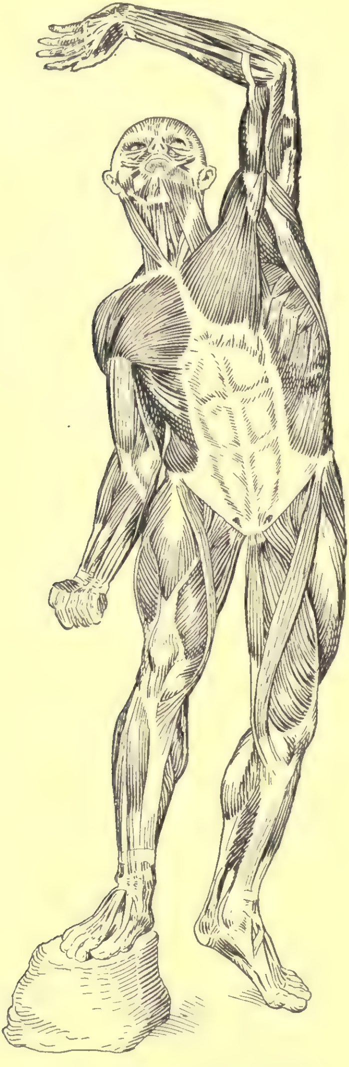

FIG. 4. — **The Muscular System**

(Copy of a Froshe Anatomical Chart published by A. J. Nystrom, Chicago. Used by permission.)

# CHAPTER IV

## CONTROL THROUGH EXERCISE

"Health is the vital principle of bliss, and exercise, of health."
—*James Thompson* (1700–1748).

Of the various agencies that touch and influence health, the value of none is more generally recognized than that of physical exercise. Properly taken, exercise makes for bodily strength and vigor; its omission is an indirect cause of disease. That the need for exercise is fundamental is revealed both by the body plan and by individual and racial experience.

**Exercise and Primitive Life.** — In the immensely long period during which man was strictly an outdoor animal, the muscular system was the all-important energy outlet. Food, shelter, contest — everything that constituted the struggle for existence on an animal basis — was dependent upon bodily movements. These were so constant from day to day, and so closely associated with the animal's existence, that the vital processes became adjusted to them as an established condition. The force developed through external muscular work was utilized in breathing, circulation, digestion, and the elimination of waste. Because economy of structure and of operation was fundamental in the preservation of the race, this plan was of great advantage in the days of prehistoric struggle. Its value, however, depended upon activity. If for any reason the animal became inactive, its internal processes became less effective.

With a large and ever increasing number of people the necessity that forced primitive man to exercise no longer exists. Electricity, water power, and steam have largely replaced muscular power, though the body plan has altered to only a slight degree. This has given rise to a special problem of health — that of *providing* muscular activity, or exercise. To appreciate the seriousness of this problem we have only to note the extent of the motion-producing apparatus of the body and the relation which it sustains to the vital processes.

**Motion-Producing Apparatus.** — That man, first of all, is a motion-producing organism is indicated by the proportion of his body devoted to this purpose. The recognized contrivances for supplying the energy of motion, the muscles (Fig. 4), form about 41 per cent of his body; the bony framework which provides the mechanical devices upon which the muscles act (Fig. 13) forms about 18 per cent; while the controlling mechanism, the nervous system (Fig. 53), forms about 2.5 per cent. Of the remainder of his body a large part is devoted to the work of supplying the motor tissues with food and oxygen and relieving them of waste. The muscles themselves are of special hygienic interest, both on account of the marked changes which they undergo when exercise is omitted and the effect of these changes upon the bodily welfare.

**Purposes which Muscles Serve.** — In addition to their main function of supplying internal and external bodily movements, the muscles serve several minor purposes of importance. They are generators of heat. Through their chemical processes (oxidations) they supply the greater portion of our warmth. Certain muscles, notably those of the abdomen, give support and protection to delicate organs, and it is through the muscles that the movable parts of the skeleton are kept in their normal adjustments and erect postures maintained. Since our weight is constantly pressing us toward the ground, we must depend upon the tension of opposing sets of muscles (Fig. 5) to keep us from falling. In addition to these direct effects, several indirect results of special importance are secured through muscular contractions, or exercise. These require special consideration.

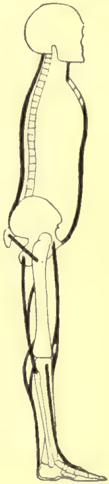

FIG. 5.—**Opposing Groups** of muscles which maintain erect position by contraction.

**Exercise and the Circulation.** — Exercise has a marked effect upon the circulation of the blood and the lymph. Proof that exercise accelerates the blood stream is found in the flushed skin and in the greater force and rapidity of the heart's contractions. Indirect evidence shows a corresponding increase in the movements of the lymph. The increase in the flow of the blood and the lymph is due in part to the stimulus which the heart receives as a result of the exercise and in part to an impetus given these liquids by the contracting muscles themselves. The method by which a by-product of muscular force is made to assist in the work of the heart is as follows:

In most of the veins are found numerous projecting flaps from the inner linings, called valves, and these open in the direction of the normal flow of the blood. Any movement in the opposite direction closes the valves, which then obstruct the flow. It is through these valves that exercise aids directly in the propulsion of the blood. Pressure from the contracting muscles pushes the blood past the valves which, on closing, prevent its flow in the opposite direction (Fig. 6). In an exactly similar manner the muscles aid in the propulsion of the lymph.

The lymph, however, is much more dependent upon muscular contractions for its movement than is the flow of blood through the veins. On this account the lymphatic vessels are much more abundantly supplied with valves[1] (Fig. 7). When exercise is omitted the flow of lymph into the thoracic duct from the lower extremities becomes much less and may cease altogether when one is in the standing position.

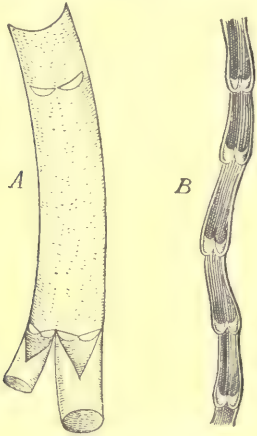

FIG. 6.— **The Valves** (*A*) of a vein and (*B*) of a lymphatic vessel. The lymphatic vessel is considerably magnified.

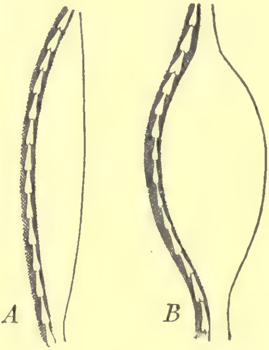

FIG. 7. — **Diagram** to illustrate lymph pumping from exercise. *A*. Muscle relaxed. *B*. Muscle contracted.

**Lymph-Mixing by Exercise.** — More important even than the increased flow of the blood and the lymph through their respective tubes, is the effect of exercise upon the lymph which is in direct contact with the cells. This fluid is a mixture of the nutritious material received through the capillary walls from the blood and of wastes escaping from the cells, and is pure or impure according to the predominance of one or the other of these substances. The contracting and relaxing of the muscles tend to force the used lymph from the intercellular spaces into the lymphatics and back into the blood, and to bring in fresh materials from the blood, somewhat on the principle of cleaning a sponge. If we desire to free a sponge of dirty water, we give it a tight squeeze and then let it soak up fresh water, repeating the process until all of the impurities have been removed. In the body the tissues correspond to the sponge, the lymph to the impure liquid, and the blood to the fresh water. Through the alternating contracting and relaxing of the muscles, the exchanges between the lymph and the blood are much more rapid than when such action does not occur.

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[1] See *Physiology and Hygiene*, pages 46 and 69, and *The Human Mechanism*, pages 147 and 148.

**Exercise and the Distribution of Blood.** — Muscular exercise is also an important factor in the general distribution of the blood. If one will take his body temperature[1] after he has been indoors and muscularly quiet all day, and again after an hour or more of moderate exercise in the open air, he will often find that his internal temperature has been lowered by a fraction of a degree. At the same time he will experience a feeling of warmth in the skin. The meaning of this change is that exercise has shifted the circulation, increasing that of the skin and diminishing that of the mucous linings. Good health requires that the blood circulate uniformly, except as changes occur to meet the needs of different parts on account of variations in activity. Exercise is especially valuable in equalizing the circulation between the skin and the mucous linings and also in preventing an excess flow of blood toward the head and a diminished flow toward the feet (pages 198 and 249).

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[1] On account of the slight differences to be observed, this test should be made with a clinical (fever) thermometer.

**Exercise and Respiration.** — The effect of exercise upon the process of respiration is even more marked than upon the circulation. During exercise breathing is more rapid and decidedly deeper. In the effort to get oxygen sufficient to supply the active cells, the lungs are freely and fully ventilated and the lung surfaces increased and toughened. Exercise does for one precisely what is done by forced deep breathing and does it more naturally and effectively (page 104). It enables the body to take in more oxygen, to rid itself more rapidly of the gaseous waste (carbon dioxide), and to fortify the lung surfaces against disease.

**Influence upon Digestion.** — Exercise benefits the processes of digestion in at least three ways:

1. It supplies a necessary stimulus to the glands of digestion, causing them to secrete their fluids in larger amounts. It accomplishes this purpose by increasing the demand for food, which in turn increases the appetite.

2. It stimulates indirectly the muscular coats in the walls of the intestines, causing them to act vigorously upon their contents (page 176). This effect, together with such assistance as may come from well-developed muscles in the abdominal walls, tends to prevent constipation with its train of evils.

3. The jarring and shaking resulting from exercise is a positive aid to the liver in ridding itself of bile and in passing this fluid into the small intestine (page 194). By this means exercise tends to prevent the serious complications which arise when the bile is interrupted in its passage.

Among the first of the disorders to appear from lack of exercise are those of digestion.

**Effect upon the Removal of Waste.** — Exercise aids in the removal of waste from the body by two distinct methods. In the first place it increases the chemical activities of the cells (page 97), thereby enabling the harmful wastes, and those that are passed with difficulty from the body, to be converted into wastes that are harmless in small amounts and such as can be easily removed. Exercise does for cell oxidation what fanning does for the flame, and as a result of the increased "combustion" there is a more complete reduction of waste. In the second place, exercise increases the rate at which wastes are expelled from the body. Especially do the lungs and the skin become more active from this cause, the lungs throwing off more carbon dioxide and the skin a greater amount of perspiration. Further aid through exercise in the removal of waste is found in the increased movements of the blood and the lymph, this causing the wastes to be passed more rapidly to the organs which expel them.

It will be noted, on the other hand, that exercise, on account of the increased chemical activity necessary for supplying the energy of motion, increases the amount of waste formed in the body. This increase is more than offset, however, by the general improvement of the eliminative processes.

**Physical Exercise and the Nervous System.** — The value of exercise in promoting good health is due to a considerable extent to its effects upon the nervous system. It is impossible to exercise the muscles without exercising the nervous system at the same time. Nor is such exercise confined to those portions of the nervous system that are in direct control of the muscles. Muscular exercise must have mental direction and this brings into action the brain, the organ of the mind. The nerve cells which are made active through physical exercise are developed and invigorated along with the cells of the muscles. Further aid to the nervous system is secured through the effect of exercise in promoting sleep. If one is physically weary on retiring he is in the proper condition for securing sound sleep — the kind which enables the nerve cells to replace the protoplasmic losses of the previous day (page 241). The best of all means for relieving insomnia is sufficient exercise.

**Exercise and Cell Health.** — Through its effects upon the blood and the lymph, upon respiration and the work of digestion, upon the nervous system, and upon the elimination of waste, exercise makes for all those conditions that improve the cells. Herein lies the explanation of its beneficial effects upon the health. One who takes physical exercise regularly and systematically is healthier than one who does not, because the cells of his body are better provided for. Their surrounding fluids are richer in food and oxygen and freer from wastes, and they receive in a greater degree the activity that renders them vigorous (page 97). Naturally, therefore, they will be more efficient in their general and special work and this will be expressed in the sum total of conditions which we recognize as health. An entirely different picture is presented when exercise is omitted to any considerable degree.

**Results when Exercise is Omitted.** The losses in bodily condition resulting from the omission of exercise are of two general kinds — those affecting the muscles themselves and those affecting the organs and processes which are in any way dependent upon the muscles. From lack of exercise, the muscles become soft, weak, and flabby, and slightly longer than when in a well-developed condition. As a result of these changes, the internal and external movements of the body are less efficient, the capacity to generate heat is impaired, and the ability to support the bodily organs and to maintain normal positions of the bones of the skeleton is diminished. The omission of muscular contractions, on the other hand, causes all the vital processes to be carried on with less vigor and less efficiency. Everything considered, there is perhaps no surer way of drifting into a state of semi-invalidism than by omitting exercise.

**Causes for the Omission of Exercise.** — If exercise is so necessary to health, how are we to account for the widely prevalent tendency to neglect it? There are three main causes for the omission of exercise, as follows:

1. The *natural* incentive to exercise lies in the necessity for motion in supplying bodily needs, and in the absence of this incentive *we have no instinct or appetite to cause us to exercise.* Hunger causes us to take food and thirst to drink water, but we may go for days and weeks even, without exercise and experience no promptings from an inner monitor. This means that, for those removed from the necessity of physical labor, exercise is not provided for in the automatic mechanism of control (page 36).

2. Fatigue sensations, if misunderstood, may cause one to desist from exercise when exercise is badly needed.[1]

Fatigue sensations are of three kinds, known respectively as positive fatigue, negative fatigue, and as chronic fatigue. *Positive fatigue* results from long-continued or strenuous exercise and is due to exhaustion of energy materials of nerve and muscle cells. To relieve this condition one must rest, and sometimes sleep and eat. *Negative fatigue* is the feeling of weariness that results from slight exertion when one is unused to exercise. It is due to the accumulation of waste in the muscle cells and in the blood. For immediate relief a short rest is required, but for removing the cause there must be a gradual increase in the amount of exercise taken. *Chronic fatigue*, or "tired feeling," is present without exercise, but rapidly increases with slight exertion, and is due to an excess of waste throughout the body. To remove the condition upon which it depends, there must be an increase of physical exercise and attention must be given to all the means for improving the eliminative processes of the body (Chapters IX and X). It is thus seen that while positive fatigue truly indicates the need of rest, the sensations of negative fatigue and chronic fatigue are apt to be misleading.

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[1] For a general discussion of fatigue, see Chapter v, *The Human Mechanism.*

3. There is a general misunderstanding of the importance of exercise from the standpoint of health. This is due in part to the slow, indirect, and variable manner by which the health is injured from lack of exercise and in part to the absence of instruction regarding the need for exercise. Unless one is convinced of the benefits of physical exercise, he is likely to devote the time which should be given to this, to study or to some other kind of sedentary task which appears important.

**Mind and the Problem of Exercise.** — By what means shall one whose vocation does not supply a sufficient amount or variety of exercise, force upon himself a régime which does? The answer to this question is found in the relation which exists between the mind and the muscles. Most of the muscles are voluntary, that is, are controlled and directed by the mind. Not only do they respond to mental stimuli, but in responding they bring into action the involuntary muscles. This leaves no doubt as to the function of the mind in supplying stimulus to exercise or its ability to reënforce and supplement the automatic system of control in this respect. The only question is that of using the mind to the best advantage for this purpose.

**Planning for Exercise.** — Mind has its own limitations. It cannot be depended upon indefinitely for supplying direct muscular stimulus — for forcing exercise for the sake of exercise. Hence *the mental effort should be directed toward the establishment of conditions which cause the exercise to be taken automatically.* To this end certain of our characteristics and tendencies may be utilized to great advantage:

1. We are creatures of habit. By setting apart a certain time each day for exercise, as a walk at the close of the day's work or some special exercise on retiring, we turn naturally to the exercise when the time arrives.

2. We are lovers of pleasure. The more we are able to supply pleasurable activities for ourselves and others, the greater is the tendency to exercise.

3. Exercise whose purpose is to supply our necessities is taken automatically. The student, for example, who rooms at one place, boards at another, and is a mile from school, will get exercise without much thinking. One should plan situations which require exercise as a part of the daily routine.

4. Everyone has a strong desire to advance his personal interests and this gives special value to a large class of exercises coming under the head of work. Most people, moreover, are able to arrange some kind of physical labor which interests them and which supplies to a large extent the need for exercise.

**Amount and Kinds of Exercise.** — The amount of exercise necessary for the maintenance of a high degree of health varies with the individual. Some require considerably more exercise than others. Because the body tends to adjust itself to a given condition, one who has always lived an active life needs more exercise than one who has lived quietly. Students, as a rule, require from two to three hours a day of light muscular work, but this time may be reduced as the exercise becomes more strenuous. One unaccustomed to exercise should begin with a small amount per day and increase this gradually as the muscles develop. The various forms of exercise may be classified, from the effects which they produce, under two heads — general exercises and special, or corrective, exercises.

**General Exercises.** — The aim in general exercise is to bring all the muscles more or less into play and to develop and maintain muscular vigor throughout the entire body. This is the kind which the normally well person usually seeks in order to preserve his health. General exercise is provided through various kinds of sports and games, through drills which bring one set of muscles after another into action, and through different kinds of work. It is generally conceded that farm and garden work, construction work, and many other kinds may supply the need for general exercise. The objection to depending entirely upon work is that it fails often to call into play a sufficient number of muscles, sometimes necessitates an abnormal position, and occasionally has to be carried on amidst surroundings that are insanitary.

The hygienic value of any form of general exercise may be judged by the variety of movements which it induces, the degree of effort which it calls forth, and the mental states which it excites. The effort should be neither too great nor too small, and the accompanying mental states should be agreeable. Physical work, it may be added, is not disagreeable to the normal, properly trained individual.

**Corrective Exercises.** — This term is applied to the various forms of exercise as well as to the methods of exercising that have for their purpose the building up of parts of the body that are weak, the strengthening of processes that are defective, and the offsetting of undesirable effects induced by environment or occupation. The general principles underlying corrective exercises are the following:

1. To exercise a given part of the body increases the amount of blood flowing to it, thereby causing it to build up.

2. To exercise a given part loosens and relaxes its tissues and improves its circulation, tending to free it from lingering wastes.

3. Exercise, if sufficiently vigorous, increases the amount of bodily heat and necessitates changes in the circulation to throw off the excess which is produced.

4. Through exercise slight readjustments of the bones of the skeleton may be secured and special muscles developed for the maintenance of correct posture.

5. Exercise removes nervous irritation and aids greatly in securing sound sleep.

**Illustrations of Corrective Exercises.** — Suppose one is inclined to stoop over while at work, and as a result is getting more and more out of shape. While aided to some degree by general exercise, he will be especially benefited by the special exercises that strengthen the muscles of the spine, the shoulders, and the neck (page 82). Again, if one has the problem of improving his digestion, he will gain most relief through the exercises that develop the muscles of the abdomen and improve the muscular tone of the stomach and the intestines. And again, if one is nervous and does not sleep soundly, he will seek some form of exercise, such as walking, which is quieting and which tends to draw the excess of blood away from the brain. On account of the specific purpose to be accomplished through corrective exercises, one cannot apply them to advantage without understanding his weaknesses and the relation, if any, which they sustain to his muscles or his methods of exercise.

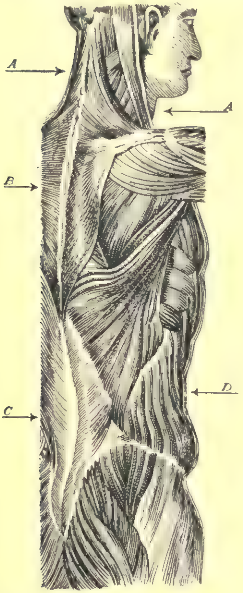

FIG. 8. — **Groups of Muscles** whose development and use aid greatly in the maintainance of good health. *A*. Muscles of the neck. *B*. Shoulder muscles. *C*. Back muscles. *D*. Abdominal muscles.

**"Health Muscles."** — There are a few groups of voluntary muscles whose development and exercise are so closely related to the maintenance of good health that they may be appropriately referred to as "health muscles." These are the muscles of the back and shoulders, the muscles of the neck, and the muscles over the abdomen (Fig. 8). The muscles of the back hold the trunk erect and prevent unnatural curves of the spine; the muscles of the shoulders maintain a proper position of these parts and prevent a cramping of the chest; the neck muscles maintain the poise of the head, preserve a proper position of the neck bones, and serve other purposes; and the abdominal muscles support important organs and aid in the propulsion of materials through the food canal. Partly on account of the importance of these muscles and partly because sedentary occupations greatly weaken them, students, and all others who are limited in their physical activities, should see that these muscles are kept sufficiently developed and active. This is accomplished through such special exercises as bring these muscles fully into play (see Health Work section, close of chapter).

**Dangers from Excess of Exercise.** — Valuable as exercise is in the upbuilding of the body and in the maintenance of good health, it may defeat the purposes for which it is intended. Like other good things of life, it can easily be overdone. Carried to excess it develops some organs out of proportion to others,[1] and it breaks down cell constituents faster than they can be renewed. Exercise which is not carried to this extreme may also be unwise and even harmful. The energy of the body is a limited quantity and that which is spent in physical exertion cannot be used for other purposes. One cannot, for example, be a great student and a great athlete at the same time. The individual, therefore, who desires to use his life forces to the best advantage will consider how much and what forms of exercise best suit his purpose and aim at that happy *balance of mind and muscle* which is most conducive to health and efficiency. While exercising sufficiently for this purpose, he will waste neither time nor energy through overexercise.

**General Suggestions for Health-Giving Exercise.** — In order that exercise may secure the best results from the standpoint of health, a number of conditions should be observed:

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[1] Excessive indulgence in strenuous exercise is liable to develop the heart, lungs, and large muscles out of their natural proportions as does training for speed in horses. While the big heart of the race horse is adapted to his present need, it is an abnormal structure for horses in general. Likewise, the student who overdoes his athletic work is likely to find himself physically as well as mentally unfitted for the sedentary occupation to which he will devote his life. This fact, together with the direct injuries that result from physical contests, has caused educators and physicians to view with alarm the stress which is laid upon competitive athletics in many schools and colleges. (See reports of Barack, Kime, and Stokes in *Transactions of Fourth International Congress on School Hygiene, Vol. iii.)*

1. Excess both as to amount and kind should be avoided.

2. It should be adapted to the individual, the weak taking little, the vigorous taking much. If one is physically weary on retiring at night it usually means that exercise for health purposes has been sufficient.

3. Moderate exercise well distributed through the day is better than strenuous exercise taken during a short interval.

4. Exercise should be counteractive, that is, calling into play those parts of the body that have not been used during the regular work.

5. When one is already tired from his regular work, exercise should be taken in moderation or omitted for the time being. One must not be misled, however, by feelings of negative or of chronic fatigue (page 53).

**Outdoor versus Indoor Exercise.** — Because outdoor air is usually freer from dust and germs, and its temperature and humidity better adapted to bodily needs, than indoor air, it is recommended that, so far as can be arranged, exercise be taken out of doors. An additional reason for this recommendation lies in the fact that exercise is for the mind as well as for the muscles. It should divert the mind, relieve nervous tension, and excite agreeable mental states. Outdoor freedom and changes of scene are much more conducive to these effects than are inclosed places. When exercise is taken indoors good ventilation should be provided, and the exercise rooms should be treated at times with disinfectants and deodorizers. Although the stale odors from lingering body exhalations are possibly not directly harmful, they detract from the enjoyment of the exercise and this makes their removal worth while.

**The Play of Children.** — Children have all the needs for physical exercise that adults experience and one additional — that of an aid to bodily growth. So great is this need that children actually experience an intense desire for exercise, or play, which is wholly absent in the adult. Play is nature's method of fortifying the advances in bodily structure accomplished by growth, and this need of the child should be supplied along with the agencies for his mental development. To make the school play effective and to obviate certain objectionable features that develop when children are left to their own devices, the exercises on the playground should be organized and supervised. The ideal is reached when the teacher is able to play with and direct intelligently the activities of the children (Fig. 9).

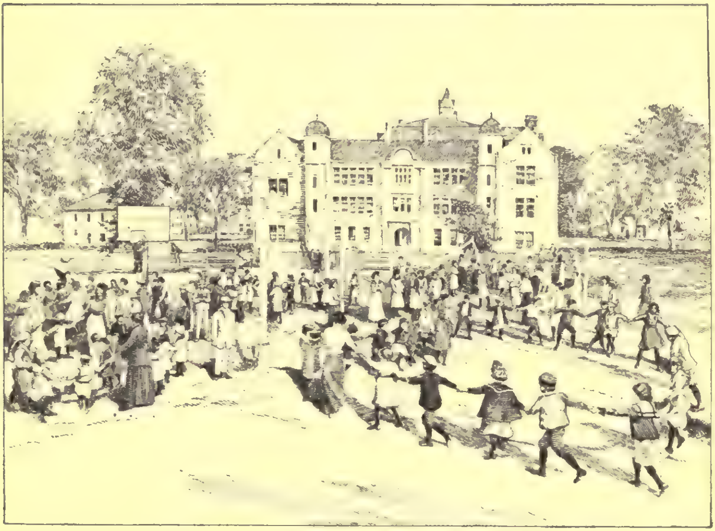

FIG. 9. — **Organized and Supervised Play.** Play is a factor in school life whose importance is too frequently overlooked.

**Passive Exercise or Massage.** — In lieu of exercise taken in the usual way, similar results may be obtained by a systematic process of rubbing, pressing, stroking, or kneading the skin and the muscles beneath by one practiced in the art. This process, known as massage, may be gentle or vigorous, and is subject to a variety of modifications. Massage is applied when one is unable to take exercise on account of accident or disease, and also in the treatment of various disorders. A weak ankle, wrist, or other part of the body, or even a bruise, may be greatly benefited by gentle massage, the pressure being applied always in the direction of the flow of the blood. A chief virtue of liniments is said to be the massage which accompanies their application. The best results, however, can only be obtained by one especially trained, and if massage is wrongly applied it may do harm.[1] It should never be applied to a boil or an infected sore. The effect, if this is done, is to spread the infection and increase the trouble.

**Summary.** — The need for exercise is fundamental, being inherent in the plan of the body. The body is so constructed that exercise is necessary to the effective working of all the processes having to do with the welfare of the cells. Although one can survive with very little exercise and may go for considerable periods of time without experiencing appreciable changes in health, disease-inducing conditions eventually arise when it is omitted beyond certain minimum requirements. The necessity for consciously looking after exercise depends upon the fact that our modern methods of living have relieved vast numbers from the necessity of manual work and the additional fact that nature has supplied no instinct or desire to replace the condition that forced primitive man to keep muscularly active. The solution of the problem lies in our knowledge of the essential needs of the body and in the energy and ingenuity of the mind which enables us to satisfy these to the best advantage.

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[1] The reduction of flesh by means of massage is considered unwise and malignant tumors (cancers) are supposed to have developed from the unskilful attempts of would-be masseurs.

**Exercises.** — 1. What effect has the omission of exercise upon the muscles? Upon the general health?

2. Account for the fact that we have no instinct or appetite to guide us in the taking of exercise.

3. Name the purposes served by muscles in a direct manner. Those served indirectly through muscular contraction.

4. In what ways does exercise lessen one's liability to take cold?

5. In what two ways does exercise assist in the circulation? Explain the lymph-mixing effect of exercise.

6. Name three ways by which exercise benefits respiration.

7. Account for the fact that those taking little exercise are frequently troubled with poor digestion.

8. In what different ways does exercise aid in the elimination of waste?

9. How does exercise strengthen the nervous system? How does it make one more courageous?

10. Show that all the values arising from exercise are due to its direct or indirect effects upon the cells.

11. What classes of people are liable to take too little exercise? Why? What are some of the indications when too little is being taken?

12. For what reasons is outdoor exercise more conducive to health than indoor exercise?

13. Distinguish between general exercise and corrective exercise. Illustrate.

14. What special value attaches to the development and exercise of the muscles of the neck? Of the shoulders? Of the back? Of the abdomen?

15. Under what conditions does exercise become harmful? Enumerate the bad effects of overexercise.

16. Why are fatigue sensations often misleading? Is the fatigue resulting from school work positive or negative? How is it best relieved?

17. What special needs for exercise have children in addition to those experienced by adults? Why should the play of school children be organized and supervised?

18. Would a daily ride in an automobile or buggy be a sufficient substitute for exercise? Compare horseback riding, buggy riding, and bicycle riding from the standpoint of their value to the health.

19. State the province of the mind in supplying physical exercise.

## Health Work

The most effective method of controlling health lies in the formation of health-giving habits. As we develop habits of doing for the body what should be done, we do not have to think about each and every separate act, but the right thing is done automatically and as a matter of course. Hence, as soon as we have become convinced of the soundness of any health principle, we should strive to embody this in a habit, thereby making it a part of the automatic method of control. A good beginning in such work is the establishment of the habit of taking sufficient exercise.

**Habit I.** *Of Exercise.* Let no day pass without an hour or more of fairly strenuous exercise, or two or more hours of moderate exercise, taken if possible in the open air.

To establish this habit requires the settled conviction that sufficient exercise is essential both to health and efficiency. It also requires such an arrangement of the daily schedule that the hour or more of muscular work can scarcely be omitted. It will be necessary in some instances to overcome an existing attitude of mind — a feeling that muscular work is something to be avoided. A few girls, for example, have a decided distaste for physical exertion. They never walk, even for short distances, when they can ride, and they have a special antipathy for the muscular work of the home. The cause of this attitude, whether it be weak muscles, the kind of clothing or foot-wear, or a misdirected sentiment, must needs be overcome. We must learn to enjoy the play or the work that brings the large muscles of the body into action. When we have the tendency to seek rather than to avoid physical exertion, we may know that we are getting the habit.

**To Test the Muscles.** — 1. *By pressure.* Press upon the muscles of the arms with the fingers, noting the degree of firmness (*a*) when they are relaxed and (*b*) when they are contracted. 2. *By the force of contraction.* With suitable instruments, called dynamometers (Figs. 10 and 11), test the contracting force of the more prominent muscles, such as those of the arms, shoulders, and thighs, making records. 3. *By endurance.* Determine the amount of physical work which can be done in a day without feeling run down and weak on the day following. This may be measured by the number of miles which one walks or by some kind of physical labor which he performs.

**To Observe the Effects of Exercise.** — 1. *On breathing.* While in a resting condition, count the number of respirations per minute, and with the sphirometer (page 115) measure the tidal air. After five minutes of vigorous exercise, again count the respirations and measure the tidal air. From the data thus obtained, estimate the increase in the volume of air passing through the lungs per minute on account of the exercise. 2. *On the circulation.* During a condition of repose, count the pulse, note the color of the skin, and with a clinical thermometer take the body temperature (mouth). After fifteen minutes of exercise, beginning gradually and increasing in vigor, again count the pulse, note the color of the skin, and take the body temperature. Record the results and account for any changes of internal temperature and of color of the skin.

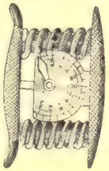

FIG. 10. — **A Convenient Device** for measuring the grip.

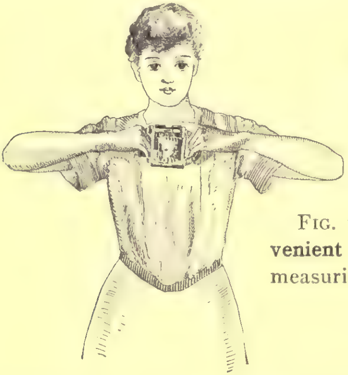

FIG. 11. — **A Dynamometer for the Arm and Shoulder Muscles,** formed by attaching a suitable frame with handles to the gripping device (Fig. 10).

**Exercises for the Development of "Health Muscles."** — 1. To *develop muscles of the back.* From an erect position with the hands at the side, bend forward until the fingers touch the floor in front of the feet and then bring the body again to an erect position. In bending keep the knees straight, and in regaining the erect position throw back the shoulders as far as possible. Any tendency for the hips to move forward in assuming the erect position should be prevented. Repeat until fatigued and after doing the shoulder exercise below, repeat again. Twenty-five times is not too often as the muscles become stronger.

2. *To adjust the shoulders, chest and neck.* (*a*) Extend both arms sideward, inclining them downward from the shoulders at an angle of 45° and turning the palms downward. From this position rotate the arms, turning the palms upward and backward as far as possible, and at the same time pushing the upper portion of the chest forward and the lower portion of the neck backward. Repeat twenty-five times or until fatigue is felt in the special muscles exercised. (*b*) Bring the hands and the arms to a level with the shoulders, palms down, elbows bent, middle fingers of the two hands touching, and the extended thumbs touching the chest. Keeping the palms down and the arms on a level with the shoulders, extend the hands as far sideward and backward as possible and then return them to the original position. Repeat many times, holding the hands each time for one or two seconds in the backward position.

3. *To develop the muscles of the neck.* Standing with the hands upon the hips and the chest forward, depress the chin slightly and push back the middle bones of the neck. Keeping this position as well as possible, exercise the muscles of the neck by bending the head from side to side and then from back to front, and again by turning the head, held in an erect position, from side to side. Repeat many times in definite order with short intermissions for emptying and filling the lungs.

4. *To develop the muscles of the abdomen and neck.* (*a*) Standing erect with the shoulders back and the hands upon the hips, bend the trunk first forward and then backward as far as convenient and then from one side to the other. Now, holding the hips stationary, give the upper portion of the trunk a twisting movement, first in one direction and then in the other. Repeat all of these movements many times. (*b*) Lying flat on the back with the hands at the sides and the head on a level with the trunk, gently lift the head two or three inches from the support contracting the abdominal muscles at the same time, and as gently let it back. Repeat until fatigue of neck muscles is felt, and then after a brief rest repeat again. Turning now to one side, repeat the head-lifting, and after fatiguing the muscles in this position, repeat from the other side. This valuable exercise for developing the muscles of the neck and abdomen is most conveniently and profitably taken on retiring at night, since it induces a restful, drowsy feeling highly conducive to sleep.

**The Game of Volley Ball.** — Any form of general exercise which causes much bending of the trunk and neck and which calls into forceful contraction the muscles of the back and shoulders, has special value in developing the "health muscles" referred to above and also in the text (page 58). Among such games, first place is usually given to volley ball, especially when played with the net a foot or two above the regulation height (Fig. 12). On account of the necessity for the players keeping their heads and shoulders back, it has a most valuable influence upon posture. It also has the advantage of accommodating a large number of either sex and of being readily adaptable to the age and strength of the players, points which make it highly valuable as a school game. (See catalogue of supplies for games and sports.)

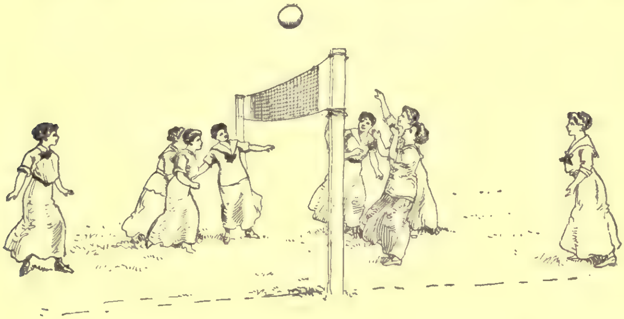

FIG. 12. — **Volley Ball.** An interesting school game which has special value in developing the "health muscles." Note positions unconsciously assumed by the different players. (Drawing made from a photograph).

**To Strengthen the Weak Heart.** — Weakness of the central organ of circulation arises from three main causes — undeveloped heart muscle from lack of sufficient exercise, an irritated or exhausted condition of the nervous system, and organic defects of heart structures. If the heart is weak from insufficient exercise, the logical remedy is to increase its work as may be done by increasing the general activity of the body. Strenuous exercise for short intervals is especially valuable, though one must be careful to avoid greater exertion than his previous training warrants. If the heart is weak from an exhausted state of the nervous system — beats too rapidly, is irregular in its action, or causes painful sensations in the heart region — but is otherwise sound, the appropriate remedy is to restore the nervous system to its normal condition (Chapter XII). Stimulants and narcotics should be avoided and the periods for rest, relaxation, and sleep should be increased.

The heart which is organically defective — valves insufficient or heart walls dilated — presents a special problem which is sometimes most difficult to solve. While such a heart is usually benefited by exercise within its capacity for work, one must be most careful to avoid nervous, as well as muscular, strain. The best plan in such cases is to rigidly follow a régime mapped out by a competent physician who is familiar with the existing condition.[1]

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[1] See Osborne's *Disturbances of the Heart.*

# CHAPTER V

## CONTROL THROUGH POSTURE

"Each man makes his own stature, builds himself." — *Edward Young.*

THE mechanical causes of disease (page 29) present great variety, and their removal, or counteraction, if they cannot be removed, necessitates work along several lines. In the present chapter we shall consider what is perhaps the most important of these lines of effort — that of preventing cell interferences through misadjustments of bodily structures, especially those of the bony framework or skeleton.

**Body Symmetry and Health.** — Though the race has always placed a high value upon the well-formed and symmetrical body, the fact has until recently been largely overlooked that lack of body symmetry is conducive to results vastly more serious than the unsightly appearance. Structural misadjustments interfere with vital processes and directly and indirectly lower the tone of health. Knowledge of this fact should be a sufficient argument for the avoidance, as far as possible, of the conditions that produce them. These include mechanical violence, diseases of the bony framework or skeleton, and the incorrect postures that are unconsciously assumed from day to day.

**Posture and the Body Plan.** — The human skeleton consists of 206 bones held together by strong ligaments, but with sufficient looseness or play for necessary movements. This framework sustains the weight of the body, preserves its general form, and provides cavities and supports for important organs (Fig. 13). Attached to the bones are the muscles for causing motion, and running through the muscles and their connections are the blood vessels and nerves. These are so placed as to derive protection and support from the muscles and bones and to avoid interferences from them.

Correct postures are in accord with the body plan and do not interfere with the normal relations of bones, muscles, blood vessels, or nerves. Their effects upon the different parts, therefore, are in all respects healthful. Because incorrect postures are antagonistic to the body plan and interfere more or less with the normal working of its different parts, their effects are in general harmful. It should be noted, however, that occasional and temporary departures from body symmetry, as in picking up objects from the floor, are not attended by harmful results. It is when they are frequent or long continued that harmful effects are produced.

**From Incorrect Postures to Permanent Misadjustments.** — The skeleton, although composed of hard materials, must be looked upon as a plastic structure. Freedom of motion necessitates a certain looseness of the joints, and the cartilage covering the ends of the bones and forming pads between the vertebræ is compressible. The ligaments, moreover, which bind the bones together, yield to constant tension, while the bones themselves are rather easily pressed out of their natural shape.[1] Because of the plastic nature of the skeleton and because of the constant pressure to which it is subjected in sustaining the

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[1] Perhaps the most striking illustration of the plastic nature of bone is the deformity produced by constant pressure upon the skull of the Flat-head Indian. The effects of foot-binding among the Chinese and of the tight-lacing once in vogue among women in our own country also demonstrate the yielding quality of bone from pressure that is constant.

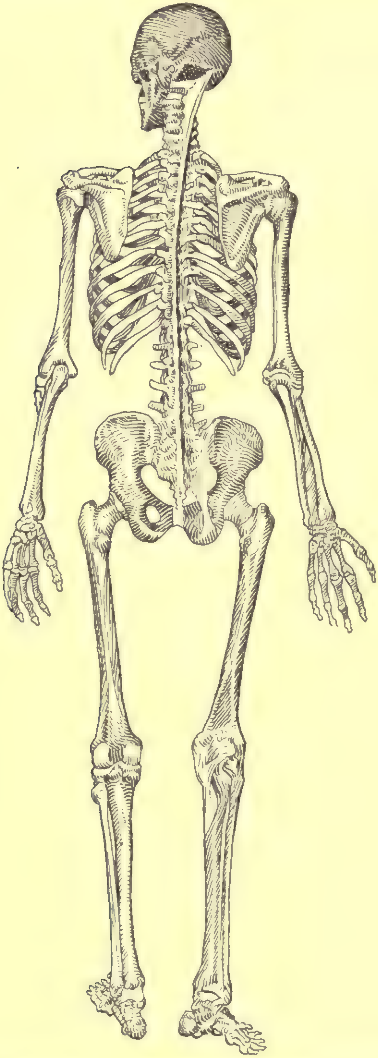

Fig. 13. — **The Human Skeleton.** Although composed of resisting materials, the skeleton is a plastic structure which yields to pressure. (Copy of a Froshe Anatomical Chart pub. by A. J. Nystrom, Chicago.)

body weight, it is easily possible for one, through bad positions habitually assumed, *to mold himself* into a much-misshapen being.[1]

**From Misadjustments to Inefficiency and Disease.** — Structural misadjustments are liable to do harm in a number of ways. They waste energy by interfering with the free movements of joints and by causing the muscles to pull at a disadvantage in the production of motion. They compress blood and lymph vessels and, by so doing, impede the movement of food and oxygen toward the cells and of wastes from the cells. And they interfere with the nervous connections of different organs and thus bring about functional disturbances. A very common type of misadjustment resulting from incorrect posture is that of the round shoulders and flat chest. This deformity obstructs breathing and predisposes to tuberculosis and other diseases of the lungs.

Of a serious nature also are the effects which incorrect posture produces upon the spinal column or backbone, and, through this, upon the other parts of the body. An unnatural curve of the lower spine may throw the head and shoulders out of their normal relation and diminish the cavities of the chest and abdomen; a crook in the neck may interfere with the blood supply to the brain, face, and neck, while the improper alignment of the vertebræ in any part of the column may compress or stretch the nerves which pass from the spinal cord to the different parts of the body.

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[1] Fortunately the molding influence of posture can, just as easily, be turned to the useful purpose of securing a symmetrical body. Through correct postures habitually assumed *we can mold ourselves into healthful proportions*. Good posture must be included in the list of conditions which, if supplied from day to day, lay the foundation for future strength and efficiency.

**An Unhealthful Tendency.** — Among all civilized people, but more especially among indoor workers, there is a decided tendency toward incorrect posture. This is observed among children in the schoolroom, workers in shops and factories, seamstresses and housekeepers and, in fact, among all those whose work is at arm's length or nearer. Nor is the manifestation of this tendency confined to the working hours of the day. Improper positions are almost as frequently assumed while leisurely sitting or standing and, with some, also while sleeping. In no period of life is the tendency absent, though it appears strongest in youth and old age — in youth because of the weakness of the tissues and in old age because of the general decline of the bodily powers. In solving the problems relative to body symmetry, the causes and conditions which underlie this tendency must be taken into account.

**Muscular Weakness a Chief Cause.** — Of the various causes which account for the tendency to incorrect posture, muscular weakness is the most general and the most important. The framework of bones is not a self-supporting structure; it cannot of itself stand alone. It devolves upon the muscles attached to the bones to bring the body into an erect position and to secure and maintain its various attitudes. If the muscles are weak, fatigue is soon felt, and to secure relief, one settles into a position such that one part is braced to some extent by another.

Then, as already suggested (page 53), the muscles in a fully developed, healthy condition are slightly shorter than in a run-down condition. If the muscles are well developed they tighten up the entire framework, holding each bone more firmly in its place. If poorly developed, there is a general looseness about the joints which makes good postures difficult. The greater tendency to assume improper positions during and following severe illness is explained by the decline in muscular power and the lessening of muscular tension upon the bones. And the frequent occurrence of postural defects among indoor people is to be attributed largely to muscular decline from the neglect of physical exercise.

**Mental Indifference.** — The muscles concerned in the establishment of proper positions are controlled by the mind. It follows, therefore, that *the attitude of mind has much to do with the attitude of body.* If one fails to realize the importance of correct posture, or realizing its importance, is indifferent to the results, persistent effort to counteract the tendency will not be made. That mental indifference has much to do with the improper positions assumed by school children is a fact well known to teachers. Physical directors in colleges and universities find that even mature students are quite indifferent to their postures, whether they be correct or incorrect. This indifference is largely due, however, to the failure of the individual to realize that consequences of a serious nature hinge upon the apparently harmless positions assumed from day to day.

**Defective Vision sometimes a Cause.** — Certain kinds of eye defects are an acknowledged cause of improper positions. The effort which the myopic, or shortsighted, person must make in order to see objects often necessitates a stooped position. In certain individuals also the eyes are so set in their orbits that with the head normally erect they are directed above the horizon. Such persons in order to see the ground at their feet must incline the head. In others the orbits are just the reverse, compelling the individuals to hold their heads unnaturally backward (Fig. 14). Again cases are found, and these are the most frequent, where the line of vision of one eye is above or below that of the other. Such persons must incline the head sufficiently to one side to bring the eyes on the same level. In some instances the improper positions assumed by people, on account of abnormal inclinations of the eyes, supply a dangerous tendency toward tuberculosis and other affections of the lungs.[1]

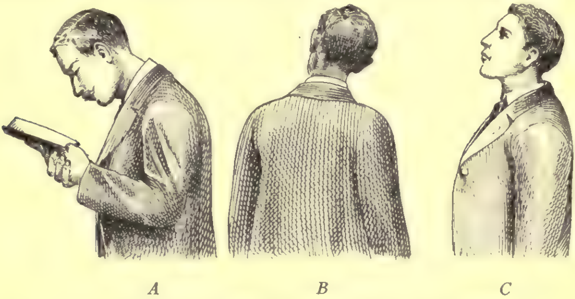

FIG. 14. — **Incorrect Postures from Ocular Defects.** *A.* Position assumed most frequently from myopia, but also from poor vision from other causes. By getting the book near the face the print is seen more distinctly.

*B.* Position frequently assumed on account of vertical imbalance of external eye muscles, one eye being inclined above the line of vision of the other.

*C.* Position due to the downward inclination of both eyes. See text.

**Clothing and Foot-wear of School Girls and Women.** — Improper clothing and foot-wear are responsible for many cases of incorrect posture, especially on the part of school girls and women.[2] Anything which impedes bodily movement tends to induce muscular weakness, and this in turn makes for improper bodily postures. Much of the clothing worn by school girls, and by adult women also, is simply "too nice" for the essential purposes which clothing should serve. The constant and studied effort to preserve "tidiness" and to keep the elaborate outfit in order, limits motion and hinders muscular development. The clothing of young girls should consist of fabrics which are not easily soiled and which stand rough usage without being unduly "mussed." Clothing, whether for children or adults, should provide for *freedom of motion* in all portions of the body — arms, legs, trunk, and neck.

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[1] Stevens, *Motor Apparatus of the Eyes.*

[2] Galbraith, *Personal Hygiene and Physical Training for Women.*

The fact is also well established that misfitting and unhygienically constructed shoes cause harmful postures, as well as interfere with the comfort and convenience of the wearer. Heels that are too high tilt the body unnaturally forward, and shoes that are uncomfortable from any cause diminish muscular activity and lead to unnatural positions in standing and walking in order to protect the feet. The two most essential requirements of shoes are roominess for the toes and an almost straightforward extension of the inner margin of the sole and upper from the shank to the toe (Fig. 15 A). The heel should not be more than one inch high.

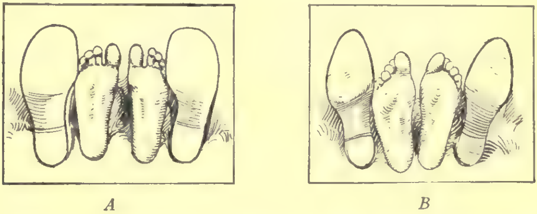

FIG. 15. — **Effects of Good and Bad Shoes on the Feet.** *A*. Correctly shaped shoes and normally shaped feet. *B*. Incorrectly shaped shoes and the deformed feet that result. (Courtesy of Dr. Lloyd T. Brown, Orthopaedic Surgeon, Boston, Mass.)

**Chairs and Other Body Supports.** — The muscles should at times relax or "let go." By relaxing one avoids fatigue and saves muscular and nervous energy. In response to this obvious need various devices, such as chairs, benches, and couches, are provided, the purpose of which is to support the bodily weight. Because these devices fulfil this purpose only in part, they enhance the general tendency to incorrectness of posture.

It has long been observed that school children are more subject to curvature of the spine and other structural deformities, than are the children who do not attend school. Although generally conceded that the faulty positions assumed were the chief cause of these defects, it was suggested that the school furniture might be responsible for the faulty positions. Investigation by experts showed that most of the types of school seats and desks then in use in our public schools were unhygienically constructed. They not only failed to support the bodies of the pupils in a proper manner, but to some extent forced the children into unnatural positions. Following this investigation was a reform movement in the manufacture of school furniture, the result being to place upon the market the "adjustable" seats and desks. These have such parts adjustable as need to be fitted to the pupil in order to support his body in a normal position for work. Such furniture is still badly needed in most of our schools and its purchase should be everywhere encouraged.[1]

What is true of school furniture is true of much of the furniture for supporting the body which is found about the home, in the office and study, and in public halls generally. Chairs in which one can read, write, sew, or study without assuming incorrect postures, and settees and couches upon which one can relax without encouraging tendencies to misadjustments are usually not found about the home and other places where badly needed. What is needed most of all, perhaps, but what is lacking in most chairs, is a suitable support for the lower part of the back (Fig. 16).

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[1] See *Physiology and Hygiene*, page 236.

**The Sleeping Position.** — Fully one-third of the time of the average person is spent in bed. This is time enough for the wrong position habitually assumed to bring about abnormal tendencies during the waking hours. If one uses a high pillow and sleeps always on the same side, a bad crook in the neck is apt to be developed. Sleeping without a pillow is little better if one lies always on the same side. During sleep the head should be on a line with the spinal column, and this is best accomplished by the use of a small, hard pillow if one sleeps on the side. If one sleeps on the back, it is better to use no pillow at all. The position of the arms is also a matter of some importance. If the arm on the side on which one lies is placed *back* of the body instead of *in front*, the shoulders are kept in a more desirable position. Sleeping on the back with-

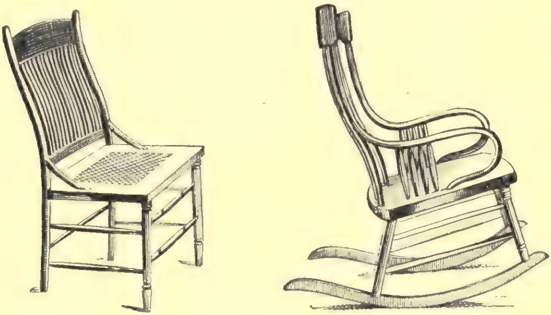

FIG. 16. — **Hygienic Chairs.** Note the slight forward curve for supporting "small of the back." Such chairs are usually no more expensive than the straight back chairs which are uncomfortable and which destroy body symmetry.

out a pillow is often a direct aid in overcoming round shoulders or a drooping position of the head.

**Relation to Vocation.** — Work which invites a stooping position is thought to be responsible for many misformed bodies, and book-keepers, machinists, students, and many others are prone to excuse their lack of body symmetry through the nature of their work. This excuse should not be accepted, however, and for the reason that the effects of the occupation can be easily overcome. Those affected are usually indifferent and make little or no effort to keep erect.

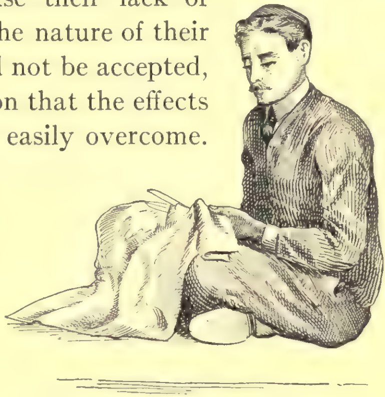

Fig. 17. — **Working Position by which the Tailor Maintains Body Symmetry.** The tailor, from whose photograph this illustration was made, was considerably stooped when he began tailoring as a young man. Although now past fifty he is almost ideally erect.

Mention may be made in this connection of two shoemakers who worked in adjacent shops in the days when shoes were made by hand instead of by machinery. At the age of sixty, one of these men was very much stooped, but the other carried himself erect and presented a dignified appearance. Furthermore, the one who was stooped was short of stature, while the other was tall. The tall shoemaker had, of course, the greater tendency to bend over his work, but realizing the danger, he resisted the tendency. As a result he attained an erectness of body greater than that of most men regardless of vocation. Tailors, as a rule, present a good appearance and for the reason that a part of their training consists in acquiring that poise of body which economizes their power and counteracts their tendency to stoop (Fig. 17).

**Correction of Faulty Postures and Structural Misadjustments.** — Serious deformities of the skeleton cannot be corrected through unaided individual effort, but must come under the treatment of specialists in this kind of medical work. In cases of slight curvature of the spine, drooping of the head, flat chest, round shoulders, and all postural habits that have not reached the stage of structural change, the individual can do much to benefit his condition. It is necessary, however, that he put thought, energy, and persistence into this work. Since in most cases years have been spent in developing the deformities, months must be spent in correcting them. On the one hand, it is necessary to remove the causes of incorrect postural tendencies, and on the other, to bring into normal relations the structures already out of adjustment. In the solution of both problems, attention must be given to muscular exercise, to correction of eye defects if such exist, to the selection of hygienic clothing and foot-wear, and to the installation, in the home and other places, of body supports that adequately serve their purpose. One is greatly helped in this work by definite ideas of

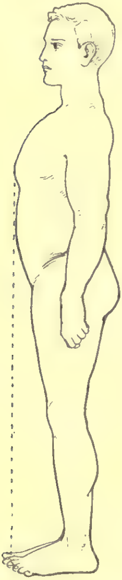

FIG. 18. — **Ideal Standing Posture.** Note the slight forward inclination of the trunk from the hips.

**What Constitutes Good Posture.** — One may be said to have a good sitting posture when he sits with the head erect, the chin slightly depressed, the shoulder blades flat against the back or only slightly rounded, the chest sufficiently high to tighten the front abdominal muscles, and the feet flat upon the floor. In standing the head and the divisions of the trunk should maintain the same relative positions as in sitting, and the weight should come squarely upon the feet, but the hips should be well back and there should be enough of forward inclination to bring the front of the chest on a vertical line with the toes (Fig. 18). The feet should extend straight forward, and a line drawn from the inner projection of the hip bone through the knee-cap should strike a line between the great toe

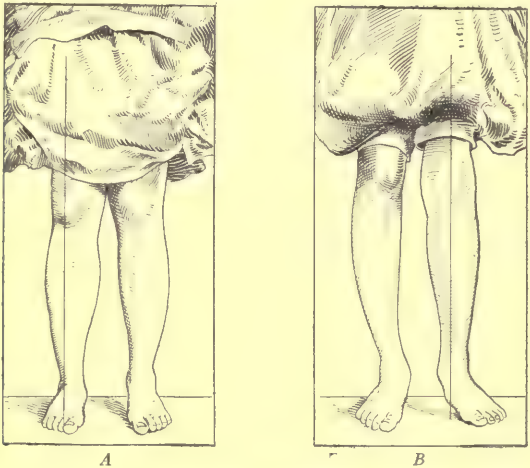

FIG. 19. — **Normal and Abnormal Feet and Ankles** (Brown). *A. Normal.* The position of the great toe is inside of a line drawn from the front, inner projection of the hip bone through the patella, and there is no sagging at the ankles. *B. Abnormal.* Extreme pronation and considerable sag.[1]

and the toe adjacent (Fig. 19), and there should be no sagging of the ankles.[1]

**Value of Exercise.** — The instrument through which we must work to secure body symmetry is the muscular system. Not only must the muscles hold up the loosely articulated framework of the bones, but it is also their function to readjust the skeleton and reëstablish symmetry that has been lost. While general exercises are valuable for increasing the muscular energy so that one is not forced into incorrect postures to avoid fatigue, special exercises for the accomplishment of definite purposes supply the chief means for postural improvements. Whenever it is necessary to substitute a correct posture for one which is faulty, we rely upon the direct effects produced through special exercises. Generally speaking such effects are of two kinds — those for the readjustment of the parts of the skeleton and those for strengthening and tightening the muscles that hold important parts in place.

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[1] A common defect of the feet, called pronation, is a decided turning out from the parallel condition. This, by throwing the weight upon the inner margins of the feet, tends to develop calloused places and foot-strain, and to render a good standing posture more difficult. Sagging of the ankles is another defect frequently associated with foot-strain and faulty posture.

**Readjustment Exercises.** — The purpose of these exercises is to reëstablish the normal relations of the bones and their attachments. Such a result is made possible by the loose fitting of the joints and the plastic nature of bone and cartilage. The method of procedure, which is simple in the extreme, is best shown by a few illustrations:

1. *To improve the poise of the head.* The adjustment exercise for the head which droops unnaturally forward is to lower the chin slightly and then to push back with considerable force the middle bones of the neck. This effort is repeated many times a day, in fact whenever one becomes conscious of the fact that he is permitting the head to depart from its normal position.

2. *To correct flat chest and round shoulders.* Two adjustments are usually necessary to improve this condition — one for forcing back the shoulders and the other for forcing forward that portion of the spine just below the shoulders — and these are best accomplished by the same effort. (See chest lifting exercise, Health Work section.)

3. *To correct slight lateral curves of the spine.* A plot of the curve is first made by some qualified person. With this in mind, the patient bends the spine backward and forward and from side to side, but applies most force to the movements which are in a direction opposite to the curve (Fig. 20).

As already stated, serious abnormalities cannot be adjusted through unaided individual effort. By the coöperation of the individual with the specialist, however, the most serious cases can be greatly improved.[1]

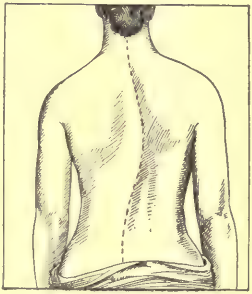

FIG. 20. — **A Lateral Spinal Curve,** the result probably of an incorrect position in writing habitually assumed.

**Development of Special Muscles.** — Mention has already been made (page 58) of the importance of the muscles that maintain correct positions of the head, shoulders, and trunk, and of special exercises (page 65) for their development. The muscles of the neck and the muscles of the back (Fig. 21) may be compared to the guy ropes which hold up a tent pole. If the ropes are loose the pole sags, and to straighten the sagging pole the ropes must be tightened. The method of tightening the muscles that support the head and trunk is that of developing them through exercise. If the pupil who has a tendency to stoop over has not already begun the work of strengthening the muscles of the neck and the back, he should not longer defer this important work.

The development of the muscles upon which the maintenance of good postures depends should be carried on with the adjustment exercises described above. The ultimate aim is to secure a condition in which *the normal positions are maintained naturally*, or without special effort. This necessitates both the adjustment of bones and the development of muscles for maintaining correct positions.

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[1] See Lovett's *Lateral Curvature of the Spine and Round Shoulders.*

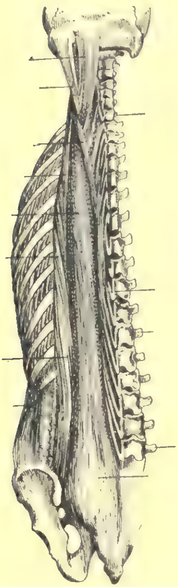

FIG. 21. — **Muscles which act on the Principle of Guy Ropes** in the maintenance of erect position. If weak and stretched these muscles let the body sag. (From Morris' *Human Anatomy*.)

**To Make the Spine Self-Supporting.** — Practically all effort toward postural improvement centers about the spinal column, the central cohering portion of the body. Normal alignment of the vertebræ means a proper poise of the head, a correct position of the shoulders, and a protruding instead of a flat chest. While much positive work in spinal improvement may be done through adjustment exercises and exercises for the development of special muscles, as explained above, equally important work is the avoidance of positions that get the spinal column out of its normal shape. In many instances this necessitates the breaking of habits of long standing, such as the following:

1. The habit while reading or studying of resting the head upon the hands with the elbows on the table.

2. The habit of hovering over close work with rounded shoulders, depressed chest, and a decided bend in the middle of the back.

3. The habit of sitting with the hips resting upon the front edge of the seat or bench, while reclining with the

middle of the back against the upright support (Fig. 39). This position tends to injure the upper as well as the lower portions of the spine.

One should sit with the hips well back upon the ordinary chair, letting the shoulders instead of the middle of the back come against the upright support. When it is necessary to bend forward, the bending should be chiefly at the hips and only to a slight degree in the vertebral column. In order to establish this habit, one should, if following a sedentary occupation, make it a rule to *sit frequently without any back support whatever* (Fig. 22).[1]

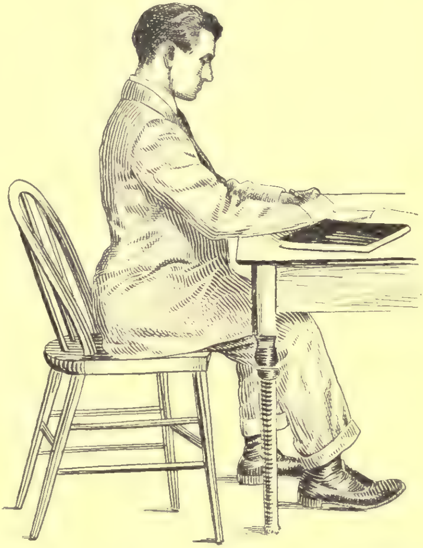

FIG. 22. — **Correct Sitting Posture** maintained without artificial support. A valuable exercise for developing good postural habit and for strengthening the back muscles.

**Is the Effort worth while?** — There is no disguising the fact that to secure and maintain body symmetry requires the expenditure of thought and energy. Hence the question arises: Are the results secured a sufficient compensation for the effort? The results secured through body symmetry are of three kinds — improved personal appearance, improved efficiency, and improved health. The improved personal appearance increases social, professional, and business opportunity; improved efficiency means greater capability in whatever work one undertakes; and improved health means general advancement toward all that human beings prize. Any one of these results more than compensates for the outlay of time and energy for securing all three. Furthermore, if the problem is properly attacked, the necessary effort can be much reduced.

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[1] While this method of sitting is somewhat fatiguing at first, it should be remembered that a small amount of muscular fatigue is by no means an undesirable condition for the brain worker and for others following sedentary occupations. The fact that fatigue is felt is proof that muscles are being exercised.

**To Prevent is Better than to Cure.** — The easy solution of the problem of symmetry is prevention. Through outdoor life, exercise, wholesome food, and the other means of keeping up muscular vigor, and through the application of corrective means for offsetting undesirable postural tendencies, the abnormalities of form do not appear. The principle of prevention, moreover, applies to cases in which abnormalities already exist, as well as to cases in which they do not, because *if these are neglected, they tend to become worse*, necessitating greater effort when their relief is finally undertaken. Hence the sooner one takes up seriously the problem of providing for a well-proportioned and erect body, the less will be the effort required.

**On the Use of Shoulder Braces.** — The use of braces for holding the shoulders back is not recommended except in unusual cases. Referring to their general use, Dr. Gulick says, "The longer a man uses braces, the less will he be able to stand up straight." [1] Another authority speaks of them as "absolutely worthless contrivances which not only take the place of muscles in holding the spine erect, but make the wearer stiff and ungainly in his motions."[1] The objection of both authorities is to the substitution of an artificial for the natural support of the skeleton. If through exercise we get the bones into their normal relations and develop the muscles whose function it is to keep them in place, we have, through natural means, provided all the bracing we need.

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[1] Gulick, *The Efficient Life*.

It is conceded, on the other hand, that well-fitted shoulder braces are an aid in the maintenance of desirable positions while the muscles are still weak and before one has been able to acquire correct postural habits, and that one with pronounced deformities will progress more rapidly in securing bodily symmetry if he make a proper use of them. In following this plan he will give much time to adjustment exercises and to exercises for developing special muscles and use the braces only during the interval when such exercises are not being taken. As soon as the muscles can be depended upon for support, he will discard them entirely.

**The Problem in Childhood.** — Correct postural habits are formed in childhood, and in childhood also are laid the foundations of curved spines, round shoulders, and other abnormalities of the skeleton. For children to develop strong, symmetrical bodies a number of conditions must be supplied:

1. There should be a liberal allowance of well-cooked, nourishing food. The building of a strong body requires good materials.

2. The child should have an abundance of outdoor exercise, chiefly play, and the opportunity for indulging in games that train for correct posture.

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[1] Pyle, *Personal Hygiene.*

3. The clothing should be of such styles and fabrics as permit the greatest freedom of motion, and the shoes should provide for the natural expansion of the feet.

4. The eyes should receive expert attention if indications suggest that bad postures arise from imperfect vision.

5. The sleeping position should be normal in all respects.

6. Corrective exercises should be employed for overcoming such physical defects and improper habits as have already been acquired.

7. Children in school should be taught the importance of correct posture and the means of attaining it.

**Posture in Old Age.** — Old age is the period in which one realizes the fruits of a life well spent or harvests in sorrow from the mistakes of younger days. Incorrect postures with their accompanying misadjustments of structure reach their culmination in the last period of life—the period when other serious handicaps are also present. One desiring length of years and efficiency in old age should plan to enter this period with the body erect and symmetrical. To do this requires that postural control be gained long before "the day when the keepers of the house shall tremble and strong men shall bow themselves."

Finally arrives the task of preserving bodily symmetry as the evening of life approaches. Danger arises from the loss of muscular power, from structural changes in the tissues of the skeleton, and from the greater liability to accidents. The old person must maintain correct postural habits. He must also keep up his exercise, but avoid, at the same time, unnecessary bodily risks.

**Summary.** — Incorrect bodily postures lead to misadjustments of structure which in turn lead to inefficiency and disease. Correct posture, therefore, is an important factor in securing good health. Since muscular weakness, mental indifference, unhygienic clothing, defective vision, and indoor life tend toward the production of incorrect posture, these must all be taken into account in securing relief. One must employ in the daily routine such corrective measures as will offset prevailing tendencies and overcome existing defects, and he must give attention to the positions habitually assumed. *It is chiefly by the maintenance of correct posture through long intervals that the body is molded into correct shape.*

**Exercises.** — 1. Name the more important of the mechanical causes of disease. In what different ways may such causes interfere with the welfare of the cells?

2. Distinguish between correct and incorrect postures. How do the latter bring about misadjustments of structure?

3. How do structural misadjustments waste bodily energy and pave the way for disease? Illustrate.

4. Account for the general tendency toward incorrect postures among indoor workers. How may weak muscles be responsible?

5. How does indifference to posture make for bad posture? Why is it necessary for the individual to feel a responsibility for his own form and carriage?

6. What conditions associated with school work make for incorrect posture?

7. Explain the dependence of correct posture upon good vision.

8. What occupations supply excuses for bad postures? Why should not such excuses be accepted?

9. Give general directions for overcoming slight misadjustments of the shoulders, chest, and neck.

10. State the principle upon which posture is improved through muscular development.

11. Describe a hygienic sitting position. When will one assume this position naturally, i. e., without thought or special effort?

12. What facts relative to the skeleton account for the molding effects of posture?

13. Enumerate the advantages of an erect and symmetrical body. Why is it easier to prevent than to correct skeletal deformities?

14. State the objection to artificial braces for the shoulders. What are the natural braces for these parts? How are these brought into efficient service?

15. Summarize conditions essential to correct posture in children.

16. State the importance of body symmetry in old age. How is it attained?

### Health Work

The facts brought out in the present chapter suggest the necessity for the establishment of a second habit — one which ranks with that of exercise in importance.

**Habit II.** — *Of Posture.* In sitting and in standing keep the head, neck, chest, shoulders, and spine in their normal positions.

The habit of correct posture is established by attending diligently to all the conditions upon which this depends and by training the mind to sensitiveness in regard to the positions assumed. This latter condition is the real test of the earnestness with which the problem is attacked.[1] One who thinks little of his postures will do little to improve them.

The effort required for health control is greatly simplified by the fact that health principles overlap. Especially is this true of the principles of exercise and of posture. If sufficient daily exercise is taken, the need for direct efforts for the attainment of correct posture is greatly lessened. On the other hand, the special exercises for readjusting the skeleton and maintaining correct postures are highly valuable for their effect upon the vital processes.

As with exercise, the general attitude of mind may need to be changed before the problem of posture can be completely solved. For example, young women who have heretofore selected their clothing and foot-wear from the standpoints of style and quality of material, must now take into consideration another item — that of adaptability to the form and plan of the body. The styles that violate laws of the body should be avoided, and for the same reason that one avoids unwholesome food and foul atmosphere. Perfection in clothing is reached only when complete harmony (physiological as well as æsthetic) is secured.

**Tests for Body Symmetry.** — (Two students working together and each helping the other.) 1. *Position of the head.* Standing with the back against a vertical wall (both the shoulders and hips touching), observe whether the head (usual position) touches. If it does not, measure the distance in inches from the back of the head to the wall and record this as the amount of forward inclination. Now stand first with one shoulder against the wall and then the other, and measure in each case the distance from the wall to a point one inch above the ear. If there is an inclination of the head to one side, state the amount of the inclination in inches, to the right or left as the case may be.

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[1] With posture, as with exercise (page 53), our automatic controlling mechanism fails to meet the healthful needs of the body. Not only are we without an instinct to prompt us to assume correct postures, but we are possessed of tendencies and surrounded by conditions whose effect is to cause us to do the opposite. Hence, as in the development of the muscles, it devolves upon the mind to supply the deficiency; knowledge must fill the gap left vacant by instinct.

2. *Shoulders and chest.* *a.* A straight, narrow board, four feet in length, with a half circle cut in the middle for the neck, is placed on the shoulders from behind, and small blocks of equal thickness are placed between the board and the shoulders for support. The distance between each end of the board and the floor is now measured, and from this the difference in height, if any, of the shoulders is calculated. *b.* With the board removed one now stands with the back to the wall, the shoulder-blades just touching, and the distance from the point of each shoulder to the wall is measured and recorded. A long ruler is then held against the chest, even with and parallel to the shoulders, and the distance from the point of each shoulder to the ruler is measured and recorded, for the protrusion of the chest. (If there is any considerable inclination of the head to one side, or if one shoulder is higher than the other, some curvature of the spine is to be suspected. In this case an examination of the vertebræ should be made by the gymnasium director or a physician and a plot made, for future reference, of any unnatural curvature that may be discovered.)

**To Correct Slight Deformities of the Neck, Shoulders, and Spine.** — Efforts for the accomplishment of these purposes are of four different kinds, as follows:

1. Special exercises for the adjustment of the bones themselves. See page 82.
2. Exercises for the development of special muscles for holding the parts in place. See pages 57 and 66.
3. General exercises for bringing up the muscular energy of the entire body (Chapter IV).
4. Efforts for the formation of correct habits of sitting and standing (page 84).

These points have all been sufficiently covered in the discussions of the present chapter and in the Health Work following the chapter on exercise.

**Chest Lifting Exercise.** — The simple act of raising the chest is a most valuable exercise for securing a normal position of the head, shoulders, and chest. As the chest is pushed up, the middle of the neck is pushed back, and while holding this position, a deep breath is taken. Because of its value in offsetting the tendency to stoop when engaged on close work, this exercise should be taken many times a day by all those following sedentary occupations.

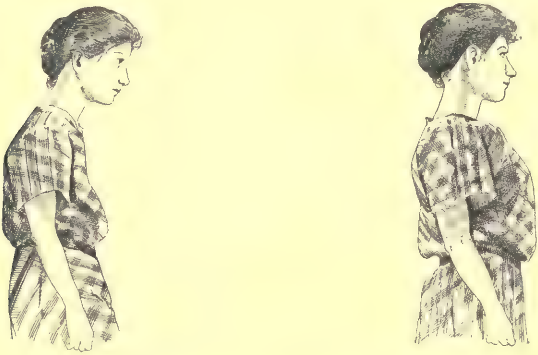

FIG. 23. — **Effects in Appearance** from the simple act of lifting the chest. The habit of frequently lifting the chest is often the means of molding the body into normal shape.

**To Relieve Stiffness and Soreness of the Joints.** — Sprains and dislocations which are at all serious, require medical attention. Slight injuries about which one would hesitate to consult a physician, may be benefited by massage (page 62), by immersing the part in hot water, or by applying towels wrung out of hot water, and by the limited use of the injured part. These simple remedies all have the effect of relaxing ligaments and tendons and of improving the circulation within them. If the stiffness and soreness linger unduly, medical aid should be sought.

**To Strengthen a Weak Back.** — Efforts to attain correct posture are frequently thwarted by weakness in the region of the back and by a lack of knowledge as to how this is to be corrected. The weakness is usually the result of run-down or undeveloped back muscles and is to be relieved by their development through a carefully graduated system of exercise. Such special exercises as do not cause strain or undue fatigue should be used, and one should form the habit of sitting independently of the back of the chair (Fig. 22). When, from fatigue, it becomes necessary to lean back, he should occupy a hygienically constructed chair (Fig. 16) or place a small support (a book or a cushion) between the straight chair-back and the lower forward curve of the spine. In either case he should sit with the hips against the back of the chair and keep the entire spinal column in its normal shape. Sleeping on the back without a pillow is often an aid in securing an adjustment of the vertebræ which enables the muscles to act to better advantage.

**To Prevent and Relieve Certain Forms of Thyroid Enlargement, or "Goiter."** — While there are several kinds of thyroid enlargement or "goiter" and one without medical training is unable to distinguish one kind from another, everyone should know that a chief cause in the production of a type of thyroid enlargement is incorrect posture. The position most likely to cause the abnormality is an abrupt forward bend in the middle of the neck, due to the attempt to keep the head erect while the shoulders and upper back region are inclined forward. It follows, therefore, that the maintenance of correct positions in sitting and standing (page 80) will prevent the development of such enlargements as are caused by bad posture and aid in the reduction of those already formed.[1] It is well for one having a goiter, however, to be careful in taking neck exercises, avoiding movements that seem to irritate the thyroid gland or that tend to increase its size.

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[1] Among students in his hygiene classes, the author knows of two cases of thyroid enlargement of long standing that were entirely relieved and several others that were reduced, through simple efforts to straighten the neck and to maintain the correct position of the head.

## CHAPTER VI

## CONTROL THROUGH AGENCIES THAT INFLUENCE THE CHEMICAL WORK OF THE BODY

"All bodily action is the translation of chemical force."— *Abrams.*

THOUGH the chemical causes of disease (page 29) present considerable variety, the most important field for their operation is found in the elaborate transformations through which oxygen and foods are made to pass in serving their purposes in the body. The present is the first of a series of six chapters dealing with the conditions underlying these causes and the means for controlling them.

**The Chemical Work of the Body.** — Something like seven pounds of materials (food and oxygen) are introduced into the average human being per day and, since the average adult does not change in weight, an equal amount passes out. In order to supply energy, rebuild protoplasm, and provide substances for special purposes, the food and the oxygen must pass through a series of processes, all of which are essentially chemical in their nature. These may be classified as follows:

1. Processes having to do with the preparation of materials for their entrance into the blood — the digestive processes.

2. Processes having to do with the passage of materials from the digestive organs to the cells and the storage of those that are not of immediate use.

3. Processes for the rebuilding of protoplasm and the elaboration of special chemical agents.

4. Processes for the liberation of bodily energy — motion, heat, and nervous power.

5. Processes for the reduction of waste to such a condition that it can be easily removed from the body.

**The Nature of Chemical Processes.** — As distinguished from physical processes, which involve changes in the form, state, and consistency of substances, chemical processes involve changes of composition. They break up existing compounds and form new compounds, and with this breaking up and reforming there are frequently energy changes of great importance. In the familiar process of combustion, for example, the ashes, carbon dioxide, water, etc., that result are the newly formed combinations, while the heat and the light are forms of energy set free by the combining process. It is because the compounds resulting from chemical action have properties[1] different from those from which they are formed and because certain chemical transformations yield much energy, that these processes play so large a rôle in the body.

**Metabolism.** — Physiologists and medical writers have employed the term *metabolism* (me-tab′-o-lism) to designate the chemical transformations produced upon substances by the body. While metabolism is frequently defined as "the changes produced by the action of living cells," we shall use the term in a somewhat broader sense to include the sum total of changes which materials undergo from the time they enter until they leave the body. Metabolism consists of two general phases or processes known as anabolism and catabolism. *Anabolism* includes the preparatory and constructive changes — those having to do with the passage of materials to the cells and the building up of cell constituents. *Catabolism* refers to the destructive or breaking-down changes — those through which substances liberate their energy or serve other purposes in the cells, and the changes necessary for the passage of wastes from the body. A point to be kept in mind is that the metabolic changes are chemical changes, i. e., changes in composition.

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[1] In digestion, for example, only slight changes in the composition of the insoluble foods produce substances which are soluble in water and which, on this account, can be absorbed into the blood.

**Impaired Metabolism and its Results.** — Metabolism is said to be *normal* when the chemical processes take place in accordance with the body plan; it is said to be *impaired*, or defective, when the chemical processes fail in some manner to occur as they should. As a result of impaired metabolism wastes accumulate in the body and harmful chemical agents (acids, etc.) are formed. This, as already stated (page 29), constitutes the most important of the chemical causes of disease. While such diseases as diabetes, gout, obesity, rickets, and certain forms of rheumatism, result directly from impaired metabolism, it may be a contributing factor in the causation of diseases of the kidneys, skin, liver, nervous system, heart and blood vessels, and also diseases caused by germs.

In addition to the serious results of pronounced impairments, there are a number of mild conditions that occur from only slight departures from normal metabolism. These include eruptions of the skin and sallowness, slight rheumatic pains, chronic fatigue, digestive weaknesses, underweight and overweight, and perturbed mental states.

These minor ailments also deserve careful consideration. By correcting them we remove the causes that lead to serious results.

**To Secure Normal Metabolism.** — To have the processes of metabolism go on as they should, requires the solution of at least four important problems:

1. That of maintaining such a degree of bodily vigor that the cells perform their chemical work to good advantage.
2. That of dertermining what materials shall and what shall not enter the body and of adjusting foods to bodily needs.
3. That of keeping the digestive organs efficient in all their work.
4. That of supplying conditions favorable to the elimination of waste.

Only the first of these problems is considered in the present chapter.

**Physical Exercise and Chemical Action.** —All the body cells function on a chemical basis, i. e., do their work through some kind of chemical change. To increase their functioning (or work), therefore, is to increase their chemical activity and this, within certain limits, renders them more vigorous from a chemical standpoint. Among the agencies that accomplish this purpose, physical exercise unquestionably ranks first. Either directly or indirectly, as shown in Chapter IV, exercise increases the work of nearly every class of cells in the body. The demand made by exercise upon the muscles for the energy of motion causes increased chemical activity not only on the part of the muscle cells, but also on the part of all those classes of cells that aid in getting food and oxygen to the muscles and wastes from them — the cells forming the organs of digestion, circulation, respiration, and elimination. Thus does physical exercise become far-reaching chemical exercise.

**Evidences of Increased Chemical Activity from Exercise.**— Chief among the evidences that exercise promotes chemical activity is the decline in bodily health and vigor that follow its omission. As a result of insufficient exercise, the body may drop to one-half or one-third of its original efficiency. Not only is there a lessened capacity for the production of motion, but there is a diminished ability to produce heat, a loss of appetite and of the power to digest, and trouble generally in the working up of material passing through the body. On the other hand, if exercise is resumed after a period of omission, the chemical processes begin at once to improve. The muscles become stronger, the appetite picks up, and the whole body becomes a more efficient transformer of energy.[1]

**Chemical Improvement from Exposure to Cold.** — Another method of arousing the chemical activity of cells is that of exposing the body for short intervals to moderate degrees of cold.[2] Since the production of bodily heat depends upon chemical changes in the cells, we supply, through exposure to cold, a stimulus to which they respond by increased chemical work. Proof that cold improves the chemical processes is found in the bodily changes that occur with the approach of winter. The appetite increases, especially for heat-producing foods, and we not only develop more heat, but become more vigorous generally. Further proof is found in the debilitating effects that result when we overprotect the body against cold, a condition often developing in which we chill with great readiness and are lacking generally in bodily vigor.

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[1] See *Physiology and Hygiene*, Chapter xii.

[2] There are certain forms of exposure to cold that do harm instead of good, and this accounts for the sensitive apparatus which we have for protecting ourselves against low temperatures. Overexposure to cold exhausts the body as does overexercise. The cold bath which is too prolonged, or which chills the surface too much, may cause local deposits of waste and produce congestions at the joints, muscles, or mucous linings. Prolonged chilling under circumstances in which the body is inactive, as in sleeping under insufficient bed coverings, or in sitting in rooms that are too cold, does harm rather than good. Though it is important that chemical vigor be developed until one is able to keep warm under normal conditions, it is also important that one be comfortably warm most of the time, even if unusual conditions must be temporarily provided.

With exposure to cold, as with exercise, the natural tendency is to do the opposite of what is best for the body. Instead of getting out during the winter months and developing a greater capacity for generating heat, many people reduce their capacity by keeping too much indoors, occupying overheated rooms, and wearing an excess of clothing. The average American home is kept too warm — the temperature ranging from 72° to 75° F. instead of from 68 to 70. The temperature of the sleeping room should not be over 60°. The body needs exercise in the production of heat as well as in the production of motion, and this is not obtained through overprotection.

**Winter as an Aid to Chemical Vigor.** — For many reasons winter should be the most healthful season of the year. The greater purity of the air and the absence of flies, mosquitoes, and other harmful insects, and of many varieties of bacteria, are conducive both to health and physical comfort. That the healthful effects of winter are not realized by some people is because they fail in their chemical adaptation. Preparation for winter is an established law for many kinds of life. Not only do animals increase their protective coverings, but each, according to its nature, makes an internal, or chemical, preparation. Most of them take on fat and become more vigorous generally. The body of man undergoes a like change provided he does not, by artificial heat and extra clothing, surround himself with a tropical temperature. Winter must be met and conquered on her own terms, and the method is to get out of doors, breathe the cold, crisp air, and develop the muscles. Such exposure, graduated to the individual, forces the chemical processes to a higher degree of efficiency and develops a resistance to the winter diseases.

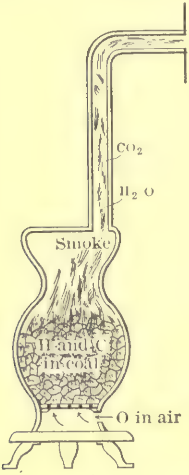

FIG. 24. — **Passageway for the Simple Draft of a Stove.** By regulating the draft one is able to control the rate of combustion.

**Importance of Oxygen.** — The most fundamental and far-reaching chemical process of the body is the one known as oxidation, and much of the work for promoting chemical activity has particular reference to this process. The term *oxidation* means in general the uniting of oxygen with other elements and, as it occurs outside of the body, may be either slow or rapid. A good example of slow oxidation is the rusting of iron, while the various forms of combustion are recognized as rapid oxidations. The oxidations of the body are sometimes referred to as a burning process, or combustion, but since they take place slowly, and at relatively low temperatures, they are not such in the true sense. The importance of bodily oxidations is shown by the fact that they supply energy, reduce harmful to harmless wastes, and make possible the other forms of chemical activity.[1]

For keeping up its oxidations the body is dependent upon the free oxygen of the atmosphere. By the process of respiration the lungs introduce the oxygen into the blood and by the blood it is distributed to all the cells. Chief among the wastes formed by the uniting of the oxygen with the constitutents of the cells is the gaseous compound, carbon dioxide ($CO_2$). This is passed from the cells into the blood, whence it is removed and passed to the outside atmosphere by the lungs. All conditions tending to facilitate either the passage of oxygen to the cells, or of carbon dioxide from the cells to the outside atmosphere, are aids in the chemical work of the body in that they assist in the fundamental process of oxidation.

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[1] See *Physiology and Hygiene,* Chapter viii.

**Respiratory Draft.** — As the draft through the stove or the furnace (Fig. 24) depends upon certain well-defined conditions — height of chimney, size of openings through which the gases pass, and the difference in temperature between the moving air column and the outside atmosphere — so does the movement of gaseous materials (oxygen and carbon dioxide) into and from the body take place according to well-defined laws. The respiratory draft, so to speak, depends upon many conditions — the method of breathing, the condition of the surrounding air, the condition of the blood, the activity of the cells, etc. — most of which are under control (Fig. 25).

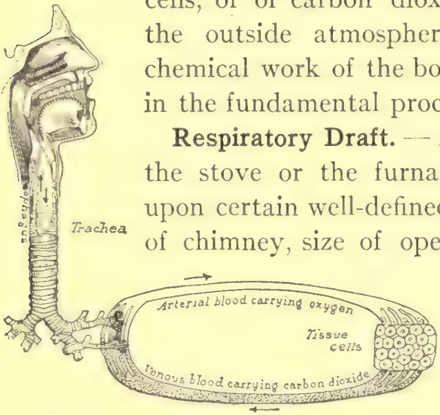
ophagus
Trachea
Arterial blood carrying oxygen
Tissue cells
Venous blood carrying carbon dioxide

FIG. 25. — **Passageways for the "Respiratory Draft."** Although the movement of oxygen into and of carbon dioxide from the body is considerably more complicated than the draft of a stove or furnace, it can, nevertheless, be so regulated as to improve the processes depending upon it.

**Breathing and the Exchange of Gases at the Lungs.** — Breathing is a process by which outside air is mixed with air already in the lungs and small portions of this mixture passed at regular intervals to the outside atmosphere. The readiness with which oxygen enters the blood and carbon dioxide escapes, depends upon the composition of this gaseous mixture. The greater the per cent of oxygen which it contains and the less the amount of carbon dioxide, the more readily will the exchanges between the blood and the air in the lungs take place.

With the average person, the air entering the lungs at each inspiration and passing out at each expiration, called the tidal air, is about twenty-five cubic inches, or about one-eighth of the air contained in the lungs, but in the so-called shallow breather, it may drop to half this amount. Since it requires about ten cubic inches to fill the system of tubes that connect the outside atmosphere with the different portions of the lungs, referred to as the *bronchial tree* (Fig. 26), the breathing of only twelve or fifteen cubic inches would scarcely permit the fresh air to enter the minute spaces (*alveoli*) where the exchange of gases takes place. In this case one must depend upon diffusion (the mixing of gases on account of their molecular movements), aided by slight air currents, for bringing the oxygen into contact with

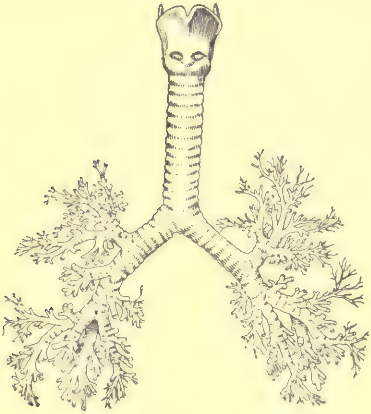

FIG. 26. — **The Bronchial Tree.** The air drawn by any breath into the places where exchanges with the blood take place must be in excess of what is required to fill the passages that connect the minute lung sacs with the outside atmosphere.

the lung surfaces and for getting the carbon dioxide into the outgoing current. This must necessarily have a retarding effect upon the entrance of oxygen into the blood and the passage of carbon dioxide from it.

**Full Breathing.** — Generally speaking, the fresh air which penetrates the minute air-sacs at each inspiration is the excess of what is breathed over the amount which is necessary to fill the bronchial tree. Breathing in such a manner that the excess may be considerable is known as full, or deep, breathing. There are two general methods for securing full breathing and these may be designated as the natural, or automatic, method and the voluntary method. The natural method depends upon a strong demand for oxygen by the cells — a demand which can only be secured through physical exercise.

Exercise calls for an increased output of energy and this, as already stated, requires increased oxidation at the muscle cells. More oxygen must be introduced to supply the increased demand and this, through an automatic mechanism, leads to quicker and deeper breathing. One living an active, outdoor life has forced upon him this natural method of full breathing so that he usually needs to give little attention to the matter of inflating his lungs. The indoor worker can avail himself of this method only by engaging at frequent intervals in active exercise, such as rapid walking, running, different kinds of outdoor work, hill climbing, and athletic games and sports. Hence he is more dependent upon the voluntary method of full breathing.

**Full Breathing from Mental Stimulus.** — This consists in filling the lungs by voluntary effort and without regard to the need of the cells for oxygen.[1] The process is a simple one and may be carried out in any position — standing, sitting, or lying down. A favorite method is to stand before an open window or out of doors, with the hands upon the hips, and to inhale slowly through the nose, raising the shoulders slightly as the air enters.[2] The air is held in the well-filled lungs for a short interval, after which it is slowly expelled through the nose or the mouth.

A better plan, however, is to have no particular time or place for taking the breathing exercise, but to practice full breathing whenever one thinks of it and to avail oneself of every opportunity for outdoor exercise. The aim should not be so much to increase the chest capacity by distending the lungs as *to establish the habit of taking in more air at each breath*, or to increase the tidal air.[3] To this end the full use of the diaphragm is especially recommended.[1] Not only is full breathing more easily accomplished through the use of the diaphragm, but its movements supply a gentle massage to the organs of digestion which is most beneficial (page 177).

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[1] As regards the value of full breathing from mental stimulus there are, among physiologists and physicians, decided differences of opinion. One class claims that the automatic mechanism for breathing is sufficient in itself for bodily needs — that as the cells require more oxygen, changes in the blood (increase of carbon dioxide and diminished oxygen) stimulate the respiratory center to increase the depth and rapidity of breathing. The other class finds in the conditions of indoor life, especially in protracted mental work, causes which inhibit the respiratory center and render it less sensitive and which, moreover, diminish the resistance of lung surfaces to attacks of disease. This class finds in forced breathing a means of offsetting a dangerous modern tendency.

[2] Raising the shoulders aids in filling the upper lung spaces by relaxing the breast muscles, while attempts to push forward the chest and square the shoulders during inhalation has the opposite effect. Hence if the breathing exercise is combined with an effort to improve posture the adjustment of the shoulders should follow, and not be coincident with, the act of filling the lungs.

[3] One who has had tuberculosis, pneumonia, or hemorrhages of the lungs, should practice deep breathing with care. He should avoid straining and any attempt to pack the lungs with air, since this may injure weakened surfaces or open partly healed sores.

**Condition of the Blood.** — An essential part of the body draft is the double movement of oxygen through the blood — the movement of the free, or atmospheric, oxygen toward the cells and the movement of the combined oxygen (in carbon dioxide) from the cells. In this, as in the movement of air through a stove or furnace, the entrance of the free oxygen depends upon the escape of the carbon dioxide.

The blood carries the oxygen to the cells by means of the hemoglobin of the red corpuscles. At the lungs the oxygen and the hemoglobin unite, on account of the oxygen pressure, to form a weak compound (oxyhemoglobin) which breaks up in the capillaries near the cells because of the reduced oxygen pressure within the body. The released oxygen then passes through the lymph into the cells.[2] The carbon dioxide passes from the cells, where it is formed, through the lymph into the blood. Here it combines in part with the constituents of the plasma (with proteins and with sodium carbonate, page 195) and in part with the hemoglobin of the red corpuscles. The ability of the blood to carry the oxygen and the carbon dioxide, therefore, depends upon the maintenance of its normal composition.

**Conditions that Improve the Ability of the Blood to Transport Oxygen and Carbon Dioxide.** — These may be grouped under two heads — those that increase the number and improve the quality of the red corpuscles and those that keep the plasma charged with constituents that enable it to carry the carbon dioxide. It is a well-known fact that outdoor life and exercise have a beneficial effect upon the red corpuscles, increasing their number as well as their content of hemoglobin.[1] The conditions that improve the plasma include outdoor life and exercise, good digestion, a proper use of foods, and the thorough elimination of wastes. As shown later (pages 134–137), conditions that lead to excess of acids in the body, tend to interfere with the passage of carbon dioxide through the blood.

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[1] The diaphragmatic is the method of breathing employed largely by the lower animals. It is a matter of some interest that men employ the diaphgram naturally in breathing, while women, as a class, do not. This difference is accounted for largely through differences in dress.

[2] *Physiology and Hygiene*, page 109.

**Effects from Inclosed Air.** — That abnormal bodily conditions indicative of chemical interference arise when people are exposed to the air of poorly ventilated rooms has long been known,[2] although we have until recently been misled as to their cause. Since breathing removes free oxygen from the air and adds carbon dioxide to it, our natural inference has been to ascribe the unpleasant and sometimes serious effects to these causes. It has been fully demonstrated, however, that even in crowded rooms the amount of oxygen removed and the carbon dioxide added is insufficient to cause immediate harm or unpleasant sensations so long as the physical properties of the air are what they should be. In addition to its chemical changes, the air in poorly ventilated rooms is apt to become overcharged with moisture, to get too warm, and to have too little movement — to become stagnated, or "dead," as it were. It is mainly to these physical changes that the unhygienic effects of vitiated air are now attributed.[1]

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[1] Borchman gave blood tests to nineteen boys and eighteen girls before a two months "summer colony" outing and again after their return. With the boys the red corpuscles had increased on the average from 3,884,000 per cubic millimeter to 4,480,000; with the girls from 3,760,000 to 4,448,000. In addition to this gain of nearly a million of red corpuscles per cubic millimeter, there was a marked increase in the percentage of hemoglobin in the corpuscles. Borchman also tested eight of the girls two months after their return to school. In five of them he found a decrease of about two-thirds of a million of corpuscles as compared with the second count.— Reported by L. M. Terman in *Popular Science Monthly*, March, 1914.

[2] Headache, dullness, depression, dizziness, collapse, and, in extreme cases, death result when people are confined in poorly ventilated places. In the tragedy, known as the Black Hole of Calcutta, 146 prisoners were confined for ten hours in a room only eighteen feet square and with but two small windows, both on the same side. At the end of the period, only twenty-three were alive and these were in a horrible condition. After the battle of Austerlitz, 300 prisoners were placed in a cellar in a small prison. In ten hours 260 had died from impure air. These are of course extreme cases.

**How Physical Causes Produce Chemical Effects.** — As a result of the physical condition of the air in poorly ventilated rooms, difficulty is experienced in regulating the body temperature. The warmer the air and the less its motion, the greater the difficulty in keeping cool, this difficulty increasing as the air becomes surcharged with moisture. In the effort to throw off bodily heat, an excess of blood is circulated in the skin and a diminished amount in the brain and internal organs. This interferes with brain activity and accounts for the feelings of lassitude and dullness resulting from "bad air." Then as conditions grow worse there is an actual rise of body temperature which may excite undesirable changes at the cells. Air lacking in movement makes temperature regulation still more difficult, since it causes a layer of air which has become saturated with moisture to remain in contact with the body, thereby lessening the evaporation of perspiration. Such an "aerial envelope" may also cause one to rebreathe the air from his own lungs. Proof that vitiated atmosphere injures the body *through interference with temperature regulation*, thereby causing overheating, is found in the fact that the results are quite similar to those caused by overheating from other causes.[1]

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[1] Investigations upon which these conclusions are based have consisted, for the most part, in the confinement of people in small, air-tight compartments so arranged that the physical and chemical properties of the air could be controlled. In all such experiments, even when continued to the point at which the air could no longer support combustion, it has been possible to prevent the disagreeable symptoms by keeping the air in motion, cool, and relatively free from moisture. Dr. Leonard Hill, for example, placed eight men in a closed air chamber of 106 cubic feet capacity. At the end of half an hour their faces were congested and they manifested great distress, but were relieved by simply stirring up the air and cooling their bodies with electric fans, no fresh air being admitted.

**Effects from Chemical Causes also Possible.** — The discovery that the *immediate* effects of vitiated atmospheres are due to physical causes does not, of course, disprove the possibility of remote and even serious effects from the continued breathing of air slightly deficient in oxygen and containing a slight excess of carbon dioxide. The *readiness* with which the body introduces oxygen and throws off carbon dioxide is diminished as air departs from its normal composition,[2] and it is not unreasonable to suppose that this may interfere in some manner with the chemical processes.

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[1] Death from overheating is easily explained on the ground that heat facilitates all kinds of chemical action. A high body temperature may cause decomposition of cell constituents and the production of poisonous compounds.

[2] As is well known, oxygen enters the blood and carbon dioxide leaves it through a process of diffusion. Each diffuses from a place of greater to a place of less abundance — the excess of free oxygen in the air causing the oxygen to enter the blood, while the excess of carbon dioxide in the blood causes this gas to enter the air spaces in the lungs. The greater the percentage of oxygen in the air and the less carbon dioxide, the more rapidly will the diffusion process occur and *vice versa*. Hence to increase the carbon dioxide in the air by ever so little is to hinder by so much the free passage of oxygen through the body.

A chemical factor, however, about which there can be no doubt is the odoriferous (organic) material which passes from the skin and air passages into the atmosphere. While investigators differ in their conclusions regarding the toxic effects of this so-called "animal matter," it is known to produce, through the sense of smell, disagreeable and depressing mental states. To avoid this effect, if not to remove a toxic influence, there is general agreement that the air should be kept relatively free from organic material.

**Effects Secured through Ventilation.** — In the light of what is known and of things of which we have some evidence, but which have not as yet been proved, the system of air management for rooms and public buildings should secure four conditions:

1. A slight but continuous movement throughout the entire inclosed space. This, by constantly changing the air next to the body, prevents interference with the evaporation of perspiration and direct rebreathing.

2. A degree of warmth (68° to 70° F.) which is best adapted to the regulation of body temperature.

3. A degree of humidity (50% to 70%) which neither interferes with evaporation from the skin nor tends to dry up the mucous linings of the air passages.

4. A degree of chemical purity of the air which obviates disagreeable odors and which makes surer the continued maintenance of health and efficiency. According to present standards, the amount of carbon dioxide should not exceed .06% (Rosenau).

Obviously these conditions may be supplied by widely different systems (see Health Work section). A recent innovation in the ventilation of school buildings and other large gathering places is the recirculation and washing of the air, a system which greatly reduces the cost of fuel. To render this system effective, sufficient fresh air is admitted from the outside to keep up the standard of purity.

**Advantages of Outdoor Life.** — Many conditions combine to make outdoor life of special value in keeping up the chemical processes of the body. Outdoor life supplies a constant stimulus to physical exercise. The chemical composition of outdoor air is usually ideal, while the continuous variations of temperature, moisture, and air movement keep the temperature regulating system of the body in a constant state of activity. Since this necessitates frequent shifts of the circulation (page 199), the muscular coats of the blood vessels are kept active and vigorous. Direct sunlight, moreover, which is so essential to the chemical processes of plants, may also aid in the chemical processes of the body. While a part of every day should be spent out of doors, summer is

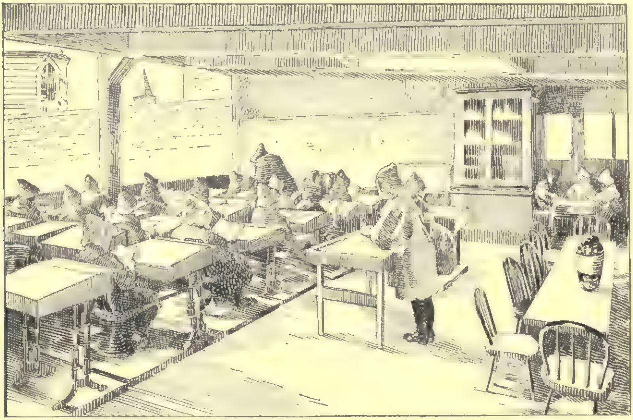

FIG. 27. — **An Open Air School** (Keyes). Each pupil is warmed by his own heat and acquires chemical vigor in generating it.

the season when one can avail himself most fully of the advantages of life in the open.[1]

**The Summer Adjustment.** — The fullest advantage possible should be taken of the mild summer weather for increasing outdoor activities. The one fundamental precaution to be taken is the avoidance of overheating, and this is accomplished by observing the following conditions:

1. Limit the quantity of food to the needs of the body. Overeating increases the difficulty of temperature regulation.
2. At some period each day exercise vigorously enough to cause free sweating.
3. Begin each day with a cold bath tempered to the condition of the body (page 200).
4. Be sure that the clothing is light and loose-fitting.

Such an adjustment to summer enables one not only to escape the lassitude and dullness so frequently associated with this season of the year, but also to carry on mental work with the same energy as during the cold days of winter. Such an adjustment is, moreover, the best preparation for a right use of winter, to which reference has already been made.

**Summary.** — Many diseases are due to chemical causes and much of our physical weakness, not yet advanced to the stage of disease, is of chemical origin. This is because the entire body is operated upon a chemical basis, deriving its energy, its needed materials, everything, in fact, through means that are essentially chemical. While the chemical processes of the body are influenced indirectly in a great variety of ways, they depend directly upon a proper functioning of the cells, and for keeping up cell work we are dependent upon physical exercise and other causes that excite their activity. Secondary to cell exercise are the conditions that influence the passage of oxygen to the cells and carbon dioxide from them, and important among such agencies are exercise, full breathing, healthy blood, and the proper physical and chemical condition of the surrounding air. Outdoor life, through the stimulus to exercise which it affords and through atmospheric conditions which harmonize with the plan of the body, is a most important general means of improving the chemical processes.

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[1] A most practical demonstration of the hygienic value of outdoor life is found in the health improvement of weak children who attend outdoor and open-window schools. Those unfamiliar with these schools should read articles on Open-Air Schools in *Transactions of Fourth International Congress on School Hygiene*, Volume II. Our illustration (Fig. 27) is from the article by Dr. Harold Brown Keyes, of the Teachers College, New York City, on "Effects of Outdoor and Indoor School Life on the Physical and Mental Condition of Children."

**Exercises.** — 1. Name and give the purpose of the main chemical processes of the body.

2. How does a chemical differ from a physical change? What two kinds of results attend chemical changes? Show by illustrations that the body uses chemical changes for both results.

3. Define metabolism. When is metabolism said to be "impaired"?

4. How does impaired metabolism cause disease?

5. State a general method for increasing the chemical activities of the cells. Why is physical exercise the most important of all agencies for this purpose?

6. How may exposure to cold be used to increase chemical activity? When does such exposure become harmful?

7. How may winter be used to promote chemical vigor?

8. Explain the term oxidation. What purposes are served by oxidations at the cells? How are the oxidations made continuous?

9. Explain the phrase "respiratory draft." Upon what does it depend?

10. What are the advantages of full over shallow breathing?

11. What physical and chemical changes occur in the air of an inhabited room? Upon what does the discomfort induced by such air depend?

12. How may the physical condition of the air affect the chemical processes of the body?

13. Enumerate the conditions supplied through efficient ventilation. Why is each condition essential?

14. What are the proofs that sunlight stimulates chemical changes in plants? In human beings?

15. How is summer to be turned to good account in improving bodily conditions? How are the bad effects of summer heat to be avoided?

16. Why are the chemical processes of students frequently below normal? What is the remedy?

## Health Work.

In the work of keeping up and improving the chemical processes of the body, the habits of exercise and correct posture, the establishment of which has already been undertaken, are of great importance. To these habits we may now add a third — one which will aid in many ways in the control of health.

**Habit III.** — *Of outdoor life.* Spend from one to three hours each day in some kind of outdoor activity.

The necessity for this habit lies in the fact that the human body is naturally adapted to an outdoor environment. Because the animal body developed out of doors, the automatic mechanism for control is adjusted to the conditions thus supplied. The establishment of this habit is also a means of causing one to give more attention to his indoor environment — to see to it that the living, working, and sleeping rooms are properly heated, lighted, and ventilated.

It is well to remember, however, that any law of hygiene becomes unhygienic if carried too far. Hence in our enthusiasm for things hygienic we should avoid making others uncomfortable. It is just as necessary to keep warm as to supply proper atmospheric conditions, and some are very easily injured by drafts. Health control depends not upon the overemphasis of any one principle, but upon the harmonious application of all of them.

**Prevention of Colds.** — If the habits of exercise, posture, and outdoor life are becoming established, definite results in health improvement will in many instances be observed. One such result is an increased resistance to attacks of colds. Although most colds are the result of germ attacks upon mucous membranes, these attacks occur because of weakened surfaces and because of disturbances of the circulation which induce congestion within their minute blood vessels. In order to strengthen ourselves against colds we must fortify the entire body, and this is accomplished through the establishment of the habits named above. Physical exercise and gradually increased exposure of the body to cold improve the heat-producing and regulating activities, while good ventilation indoors and the spending of much time out of doors, improves the circulation and strengthens the mucous surfaces. Correct posture, as explained in Chapter V, improves breathing, and this aids in several ways.

To proceed definitely toward increasing the body's resistance to colds, we put it through a graduated process of toughening, starting with what we can easily withstand and increasing the amount from day to day. When a certain stage of resistance is reached, the germ attacks are no longer successful, that is, we do not take cold. Although the immediate provocation in the way of drafts, chilling, etc., may be greater, our increased resistance gives us sufficient protection. In order to see what progress is being made, it is well to keep a record of the colds — the dates of attack, their duration and intensity.

**Treatment for Colds.**— Colds when neglected often lead to serious consequences, setting up chronic catarrhal conditions, and laying in some instances the foundation for pneumonia and tuberculosis. It is often possible to break up a cold at the onset through relieving the mucous congestion and increasing the circulation in the skin; this may be done by taking a hot bath and retiring at once to a warm bed. When the cold is well established, however, we must rely upon the body itself, rendering what aid we can through hygienic measures.

1. We must keep warm. Warmth, by improving the circulation in the skin, relieves the mucous congestions. Getting chilled does just the reverse, tending to start the cold over again.

2. We should reduce the usual amount of work and, if the cold is severe, remain in bed. The energy thus saved will be used by the body in the establishment of normal conditions.

3. After the active stage has passed we should increase the time spent out of doors, taking light exercise, but avoiding getting chilled.

4. We should avoid the use of all medicines, except a mild laxative in the case of constipation. While quinine is sometimes taken for a cold, this and other drugs tend to make the body more susceptible to future attacks. On the other hand, the curing of the cold by the body itself tends to increase its resistance.

5. When the seat of the attack is in the nostrils or throat, much may be accomplished by the application to the affected parts of medicated solutions prescribed by the physician.

6. If the attack is upon the lungs, some counter-irritant may be applied, one of the very best being the well-known home remedy of a piece of woolen cloth covered with a mixture of two parts kerosene and one part lard. The cloth should be large enough to cover most of the chest and should be kept on for some time. The irritation should be continued as long as the lungs are sore, but so modified as to avoid blistering. The irritating effect is increased or diminished by varying the amount of kerosene, while the clothing is protected by a layer of paper over the cloth.

7. When hygienic conditions and home remedies fail to give relief in a reasonable time (a few days), a physician should be consulted.[1] A cold, so called, which "settles on the lungs" is in most instances tuberculosis.

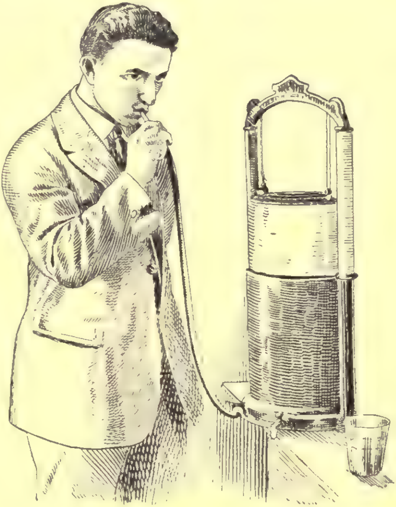

FIG. 28. — **The Spirometer.** An instrument for measuring the capacity of the lungs.

**To Use the Diaphragm in Breathing.** — Both as an aid in breathing and as a means of improving the digestion, the use of the diaphragm is recommended. The diaphragm is brought into use by inhaling air without the usual effort of expanding the chest and by filling the lower portions of the lungs first. Diaphragmatic breathing is also promoted by loose-fitting clothing around the waist.

**Respiratory Tests.** — 1. *To measure breathing capacity.* Fill the lungs completely full of air and then force as much of it as possible into a spirometer (Fig. 28), noting the number of cubic inches registered. To avoid the danger of germ transmission, the mouthpiece should be dipped each time into some disinfecting solution, such as a four per cent solution of carbolic acid in water, and then wiped dry with a towel. Instead of the solution, individual wooden mouthpieces, obtained at slight expense from supply houses, may be used.

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[1] In attacks having the appearance of colds, but of great severity or attended by unusual conditions, such as hard breathing, watering of the eyes, fever, aching of joints, or a croupy cough which lasts through the

2. *To measure the tidal air.* Breathing as naturally as possible, expel each breath into the spirometer, noting the total record for ten respirations. From this find the average amount expelled at each breath. (This test is very inaccurate unless one breathes naturally while making it.)

3. *To measure chest expansion.* With a tape line, measure the total girth of the chest (*a*) when as much air as possible is expelled from the lungs and (*b*) when they are inflated to their fullest extent. The difference in inches is recorded as the chest expansion.

4. *To measure the work of the diaphragm.* (This measurement is taken in one's room and without obstruction from clothing.) With a tape line, take the girth of the abdomen when all the air possible is expelled from the lungs and again when the lungs are fully inflated. The difference in inches is recorded as the respiratory work of the diaphragm.

**To Test Air Within Rooms.** — 1. *For temperature.* For the determination of temperature an accurate thermometer should be employed. This should be suspended a few inches from the wall in a part of the room having about the average temperature. In the school-room the thermometer should register in winter about 70° F.

2. *For moisture.*[1] The degree of humidity is best determined by the wet and dry bulb thermometer, the form generally recommended being that of the Sling Psychrometer employed by the United States Weather Bureau. (Bulletin No. 235 of the Weather Bureau describes the use of this instrument.) Good ones may be had for only two dollars.

3. *For air movements.* Slight air currents are easily detected by means of a candle flame. An atmosphere which causes no movement of a candle flame may be regarded as unhygienic. On the other hand, air which has sufficient movement to affect the senses

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day, the physician should be called at once. Such attacks are usually not colds, but the beginning of some more serious disorder, such as measles, scarlet fever, grip, or diphtheria. (Footnote, page 401.)

[1] Both temperature and excess of moisture are indicated by the physical sensations. Hence the feelings of discomfort resulting from atmospheric conditions should be given due heed.

has, in rooms of temperature below 70° F., unnecessary and, for some, harmful motion.

4. *For chemical impurities.* (*a*) *Odor.* After spending ten or fifteen minutes entirely out of doors, enter the room in question. If bodily odors are perceptible, the air is impure and attention should be given to ventilation. (*b*) *Carbon dioxide.* A simple test sufficiently accurate for practical purposes is one named from its originator, the Wolpert air test. The apparatus (Fig. 29) and chemicals for this test may be obtained from supply houses with full directions for their use. Although carbon dioxide in small amounts is not considered harmful, the per cent which is present supplies a reliable index of the chemical condition of the air.

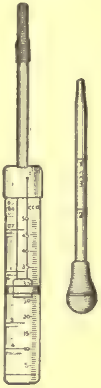

FIG. 29. — **The Wolpert Air Tester.**

**House Ventilation.** — In supplying air to rooms where ventilation is not provided through the system of heating, the following suggestions will be found helpful:

1. Introduce the air through many small openings instead of through a few large ones. Such a method usually provides sufficient fresh air and air movement, and does so without drafts.

2. Introduce the air if possible at the warmest portions of the rooms. This will enable it to become heated before reaching the occupants.

3. If the wind is blowing ventilate on the sheltered side of the house.

4. Vary the size of the openings with the severity of the weather. On the calm warm days, the windows and doors should be wide open; on the cold days, very small openings will admit sufficient air.

5. In cold, dry weather make ample provision for moisture by placing vessels of water where evaporation will rapidly occur.

## CHAPTER VII

## CONTROL THROUGH ADJUSTMENT IN FOODS

"What is food to one man may be fierce poison to others." — *Lucretius.*

In the present chapter and in the chapter following we consider the second of the great problems in securing normal metabolism — that of determining what materials shall and what shall not enter the body and of adjusting foods to bodily needs and bodily conditions. In some respects foods are life fuels. As we select fuels with reference to the conditions under which they are to be burned and vary their consumption with the demand for heat, so may we adjust foods to their purposes in the body.

**What Food Adjustments Include.** — What is comprehended under the head of food adjustments will be best understood by a comparison of the animal, or instinctive, method of eating and the method of the intelligent, well-informed human being. The animal gives little heed to the condition of his food, observes no regular period for eating, and only gauges the amount by what he can obtain and his capacity to swallow. The man is careful about the condition of his food, observes regular periods for eating, and usually gauges the amount by what experience has taught him is best. The animal is guided by instinct, the man by instinct plus intelligence.

Food adjustments are for the object either of making the materials introduced better serve their purposes or for avoiding harmful results. They include the eating of recognized foods in suitable proportions, variations in the amounts to meet the varying demand of the body for food and its varying capacity for using it, and shifts in the diet to reduce the cost of living.

### ADJUSTMENT ONE:

### *To supply essential foods in proper proportions*

Foods are classified both from the standpoint of purpose and from the standpoint of composition. From the standpoint of purpose we have three classes — tissue-building foods, energy foods, and assistive agents. The first class supplies material which can be converted into protoplasm to replace this important substance as it disintegrates at the cells; the second class supplies materials which, on oxidizing at the cells, liberate the forms of energy (heat, motion, and nerve force) needed by the body; and the third class provides compounds which are necessary to the successful operation of the body, but which do not rebuild protoplasm or liberate energy.

From the standpoint of composition we have five main classes of foods[1] — proteins, carbohydrates, fats, water, and mineral salts. The characteristics of these and their grouping from the standpoint of purpose are as follows:

1. *Proteins.* — These contain the elements carbon, hydrogen, nitrogen, oxygen, sulphur, and some of them phosphorus, and are similar in composition to cell protoplasm. Although the proteins may, through oxidation, supply energy, their essential purpose is to replenish the cell protoplasm and in this respect no other class of foods

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[1] Two classes of foods of minor importance are the *albuminoids* and the *organic acids.* The first is similar in composition to the proteins and the second to the carbohydrates.

can take their place.[1] At least five distinct varieties of proteins are now recognized. These are *albumin*, found in the whites of eggs; *gluten*, found in grains or cereals; *legumen*, found in beans, peas, and other members of the legume family; *myosin*, found in the muscles of animals; and *casein*, found in a diluted form in milk and in a concentrated form in cheese.

2. *Carbohydrates.* — These compounds contain the elements carbon, hydrogen, and oxygen. They cannot be converted into protoplasm, but on account of the ease with which they can be oxidized are excellently adapted to supplying energy. The most important of the carbohydrates is *starch*, and of this substance there are two varieties — the common or vegetable starch supplied by plants, and a kind of starch found in the liver and to some extent in the muscles of animals, known as *glycogen*. The plant compound, *cellulose*, is a carbohydrate, and so also are the different kinds of *sugars*.

3. *Fats.* — These foods contain the same elements as the carbohydrates and also serve the purpose of supplying energy. They are of two general kinds — the solid fats and the oils. The *solid fats* include butter and the fat of meat and are chiefly of animal origin. The *oils* include olive oil, cotton seed oil, and the oil of nuts, and are chiefly of vegetable origin. The fats are more complex in composition than most of the carbohydrates and are more difficult to digest.

4. *Water.* — This simple compound contains only hydrogen and oxygen as shown by its formula, $H_2O$. It is the chief constituent of milk, tea, coffee, and other bever-

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[1] On account of their importance in relation to life, the term "protein" (from a Greek verb signifying *to take first place*) is applied to these compounds.

ages, and is present in nearly all our solid foods. It is also introduced into the body in large quantities as a pure liquid, being the most important of the assistive agents.

5. *Mineral Salts.* — These include a large variety of rather simple compounds, the one used in greatest amounts being sodium chloride ($NaCl$), or common salt. They are present in small amounts in nearly all our foods, though differing in quantity and kind in the different ones. The ash which is left when any food is burned is its content of mineral salts. The mineral salts serve as assistive agents and are the means of supplying to the body elements, such as calcium, iron, potassium, and iodine, which are needed in only small amounts.

**Food Materials and Nutrients.** — It is customary to distinguish between the various substances used as food, called *food materials*, and the compounds referred to in the preceding paragraphs, called *nutrients*, which form the food materials. We deal with the food materials, that is, we raise, distribute, buy, sell, prepare, and eat food materials. After eating them our bodies separate and use the nutrients. To supply the nutrients with any degree of accuracy, it is essential that we understand what nutrients the different food materials contain and in what proportions. Chemists have made extensive analyses of food materials and have compiled numerous tables, such as the one on page 127. These, by showing the percentage of the nutrients (proteins, carbohydrates, fats, water, and mineral salts), and also the energy value of the different materials, serve as valuable guides in making selections. But in spite of this knowledge we would still be unable to supply bodily needs, if we did not know in what proportions the body requires the different nutrients.

**The Food Ratio.** — Just what part of the daily fare should consist of proteins and what part of carbohydrates and fats has not been fully agreed upon. The older investigators, basing their conclusions upon what people actually ate when they were so situated that they could satisfy their natural desires for food, placed the amount of protein at about one-fourth of the total intake of tissue and energy foods. Later investigators, considering the smallest amounts of proteins which one could get along with and still enjoy normal health and efficiency, placed it as low as one-tenth. Professor Chittenden has recently made a most careful study of the problem, and the figures which he supplies approximate a ratio of about one to eight.[1] A conservative estimate, keeping in mind all the needs of the body, would place the protein at one-seventh, the fat at one-seventh, and the carbohydrates at five-sevenths of the daily intake of tissue and energy foods.[2] Proof of the importance of a suitable ratio is supplied by recent experiments in animal feeding (Fig. 30)[3].

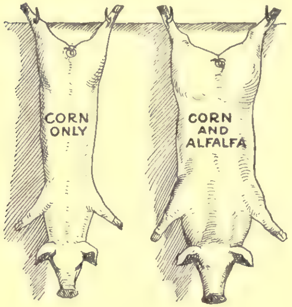

FIG. 30. — **Effects of Balanced and Unbalanced Diet** upon the lower animals. The pigs are full brothers fed in different ways. The small pig was fed on corn alone; the large pig was fed on corn and alfalfa hay.

The amount of water which is required varies with the individual and the season of the year. Being the dissolving and carrying agent of the body (foods entering and wastes leaving it are both dissolved in water), it must be taken in larger quantities than any other substance. The average individual should have from three to five

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[1] Chittenden, *The Nutrition of Man.*

[2] One may approximate this standard by *eating at each meal a small amount of some food rich in protein, a small amount of fat, but making the bulk of the meal carbohydrates and varying the diet at different meals.*

[3] Further proof is found in the development of disease from the use of unbalanced diets. The disease *pellagra*, for example, has been shown to result from a diet containing two little protein (p. 144).

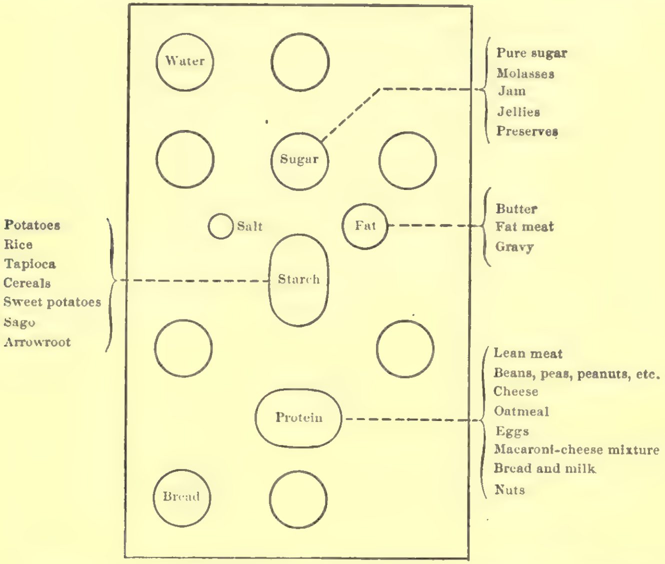

FIG. 31. — **A Table for Six.** The diagram shows that while the typical meal should supply one dish rich in protein, one rich in starch, one rich in sugar, and one rich in fat, that these dishes may be supplied through a large variety of food materials.

pints per day in addition to that which is a part of the solid food. (See Table I.)

**How the Right Proportions are Secured.** — Equipped with a knowledge of the composition of food materials and of the general proportions in which the different nutrients are required, we are ready to devise plans for putting this knowledge into practice. Chief responsibility devolves upon the one who supplies food to the table because it is she who makes possible the proper apportionment by those who partake. Each meal should supply one dish rich in protein, one or more rich in starch, one rich in sugar, and one rich in fat, in addition to supplying some harmless beverage (Fig. 31). The most ample provisions, however, do not suffice for knowledge on the part of the eater. If he does not understand food values and his bodily needs, the well-balanced meal will fail of its purpose.

According to recent investigations water may be used rather freely during meals without serious detriment to the digestive processes, provided it is not used to wash down food and thereby limit the flow of saliva. Between meals it must be taken in amounts sufficient for bringing up the total quantity to from three to five pints daily. Of special importance is the drinking of a glass of water on retiring at night and on rising in the morning (page 179).

To secure through the mineral salts all the different elements needed in small amounts by the body, requires considerable variety in the food materials supplied to the table and the free use of fruits and vegetables. Variety is supplied, however, through changes in the menu from one meal to another and not by providing a large number of dishes at each meal. For many reasons each meal should be simple, both as regards variety and as regards the method of serving.

### Adjustment Two:

### *To supply foods in suitable amounts*

To supply to the body an insufficient amount of food is to impair its efficiency. Weakness results both from a lack of material for renewing cell protoplasm and for the production of energy. And along with the physical weakness there is depressed vitality and a lessening of resistance to attacks of germs. The results of overeating are, however, more serious than moderate degrees of underfeeding, especially when overeating has become a chronic condition. Congestion of the liver, distention of the stomach and intestines, obesity, headache, lassitude, and gradual changes predisposing to diseases of metabolism, result from even mild forms of gluttony. It is true, moreover, that while only a few from different causes undereat, a vast majority take food in excess of the needs of their bodies. Our chemical processes are more apt to go on normally when the body receives neither too much nor too little food, but just the right amount.

**Conditions which Determine the Amount.** — One factor in determining the right amount of food is the general activity of the cells. It is through cell activity that the nutrients serve their intended purpose, and only as food already in the body is used, is the need created for more. By knowing the rate of consumption at the cells, we should be able to gauge the introduction of materials at the mouth. According to Atwater's estimates, the energy requirements of men doing different amounts of muscular work are about as follows:

| | | |
|---|---|---|
| Men doing severe muscular work .......... | 4,500 | Calories[1] per day |
| Men doing moderate muscular work ......... | 3,500 | “ “ “ |
| Men doing little muscular work (clerk at desk) | 2,700 | “ “ “ |

Although considerable difference is found in the estimates of investigators, the same general conclusion is reached — that the food requirement varies with the activity of the body. It follows, therefore, that as one increases his activity he should eat more, and as he diminishes his activity, he should eat less.

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[1] The Calorie is the adopted heat unit. As here used, it may be defined as the quantity of heat required to raise one kilogram (2.2 lbs.) of water one degree centigrade. It is conveniently used also in expressing relative amounts of chemical energy in foods.

Another factor in the problem is the prevailing temperature to which one is exposed. In cold weather we need more food (especially carbohydrates and fats) to maintain bodily warmth, and in hot weather we need less. A third factor in the problem is the efficiency of the digestive organs. One cannot introduce nutrients into his body beyond his ability to digest, even though there be rapid consumption at the cells. While it is true that increasing bodily activity frequently improves the digestive processes, it is also true that to eat beyond one's power to digest has the effect of further impairing them. Hence if the quantity of food that can be properly digested is not sufficient to supply the energy for work, the amount of work must then be curtailed.

**Overeating a Relative Term.** — It is evident from the facts just stated that the taking of an amount of food which would be overeating for one, might be underfeeding for another, and that it would be possible for the same person to feast and fast at different times upon equal amounts of food. In general, one may be said to overeat when he takes food in excess of his needs or in quantities greater than he can digest. Since the bodily needs and the power to digest are highly variable, we are at some difficulty in finding a reliable guide.

**Guides in Eating.** — The natural guide is the appetite and, when properly used, this serves as a reliable indicator. It is possible by rapid eating, however, to overfill the stomach before the appetite is satisfied, and also to overstimulate the appetite through the number and variety of the food preparations. Edison, in determining his food requirements, is said to have based the amount upon what

TABLE I. THE COMPOSITION OF FOOD MATERIALS

| *Food Materials* | *Water* | *Protein* | *Fat* | *Carbohydrate* | *Ash* | *Heat value of one pound* |
|---|---|---|---|---|---|---|
| Animal foods, edible portion | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Calories* |
| Beef: sirloin | 60.0 | 18.5 | 20.5 | ..... | 1.0 | 1210 |
| round | 68.2 | 20.5 | 10.1 | ..... | 1.2 | 805 |
| Veal: shoulder | 68.6 | 20.2 | 9.8 | ..... | ..... | 790 |
| Mutton: leg | 61.8 | 18.3 | 19 | ..... | .9 | 1140 |
| loin | 49.4 | 15 | 35 | ..... | .7 | 1755 |
| Pork: shoulder | 50.3 | 16 | 32.8 | ..... | .9 | 1680 |
| fat, salted | 12.1 | .9 | 82.8 | ..... | 4.2 | 3510 |
| Sausage: pork | 41.5 | 13.8 | 42.8 | ..... | 2.2 | 2965 |
| bologna | 62.4 | 18.8 | 42.8 | ..... | 3. | 1015 |
| Chicken | 72.7 | 24.4 | 2. | ..... | 1.3 | 540 |
| Turkey | 55.5 | 21.1 | 22.4 | ..... | 1 | 1360 |
| Eggs | 73.8 | 14.9 | 10.5 | ..... | .8 | 721 |
| Butter | 10.5 | .6 | 85. | .5 | .3 | 3515 |
| Milk | 87. | 3.6 | 4. | 4.7 | .7 | 325 |
| Cheese: full cream | 30.2 | 28.3 | 35.5 | 1.8 | 4.2 | 2070 |
| skim milk | 41.3 | 38.4 | 6.8 | 4.9 | 4.6 | 1165 |
| Fish: codfish | 82.6 | 15.8 | .5 | ..... | 1.2 | 310 |
| salmon | 63.6 | 21.6 | 13.4 | ..... | 1.4 | 965 |
| oysters | 87.1 | 6 | 1.2 | 3.7 | 2. | 230 |
| Vegetable foods, edible portion | | | | | | |
| Wheat flour | 12.5 | 11. | 1.1 | 74.9 | .5 | 1645 |
| Graham flour (wheat) | 13.1 | 11.7 | 1.7 | 71.7 | 1.8 | 1635 |
| Rye flour | 13.1 | 6.7 | .8 | 78.7 | .7 | 1625 |
| Buckwheat flour | 14.6 | 6.9 | 1.4 | 76.1 | 1. | 1605 |
| Oatmeal | 7.6 | 15.1 | 7.1 | 68.2 | 2. | 1850 |
| Cornmeal | 15. | 9.2 | 3.8 | 70.6 | 1.4 | 1645 |
| Macaroni | 10.3 | 13.4 | .9 | 74.1 | 1.3 | 1665 |
| Rice | 12.4 | 7.4 | .4 | 79.4 | .4 | 1630 |
| Peas | 12.3 | 26.7 | 1.7 | 56.4 | 2.9 | 1565 |
| Beans | 12.6 | 23.1 | 2. | 59.2 | 3.1 | 1615 |
| Potatoes | 78.9 | 2.1 | .1 | 17.9 | 1. | 315 |
| Tomatoes | 95.3 | .8 | .4 | 3.2 | .3 | 80 |
| Apples | 83.2 | .2 | .4 | 15.9 | .3 | 315 |
| Bananas (yellow) | 75.3 | 1.3 | .6 | 22.0 | .8 | 460 |
| Sugar (granulated) | 2. | ..... | ..... | 97.8 | .3 | 1820 |
| Peanuts | 9.2 | 25.8 | 24.4 | 38.6 | 2. | 2560 |
| Almonds | 4.8 | 21. | 17.3 | 54.9 | 2. | 3030 |
| Walnuts (English) | 2.5 | 16.6 | 16.1 | 63.4 | 1.4 | 3285 |
| Walnuts (black) | 2.5 | 27.6 | 56.3 | 11.7 | 1.9 | 3105 |
| Hickory nuts | 2.5 | 15.4 | 67.4 | 11.4 | 2.1 | 3345 |
| Cocoanut | 14.1 | 5.7 | 50.6 | 27.9 | 1.7 | 2760 |
| Pecans | 3. | 11. | 71.2 | 13.3 | 1.5 | 3455 |

was necessary to prevent, under normal conditions, a change of body weight. He began by gradually decreasing his food, weighing himself on successive days, until his weight began to diminish. He then increased the amount until the body weight remained constant. The amount thus required was taken as the standard for the conditions of activity under which the test was made.

A method which utilizes the appetite and which allows for variations in activity and in the capacity to digest food is the following: Stop eating before the desire for food is fully satisfied and observe the effect upon the energy supply and upon the desire for food. If able to work until the next meal without undue faintness and without an overkeen appetite, the previous meal was sufficient. In following this method it is also well to watch the body weight, decreasing the food when there is any undue increase in weight and *vice versa*.

One should also be guided to some extent by the symptoms of overeating, such as impaired digestion, a coated tongue, accumulations of fat, and a general feeling of dullness and lassitude following meals.

Having determined what is an adequate amount of food under the usual conditions of activity and ability to digest, we should be careful to eat in accordance with this standard. To do this the average individual will have to resist many temptations to overeat.

**Causes of Overeating.** — The unrestrained animal will almost invariably overeat when the opportunity offers. This appears to be a provision of nature to guard against the periods when food is scarce. The same tendency is the chief cause of overeating in man. In the animal enjoyment of taking food, it is very easy to introduce an excess which does harm. While it is important that we enjoy our meals, we must cultivate that restraint which places the introduction of food upon the basis of a science.

Another cause of overeating is the overloading of the table with tempting articles of food and the following of the regular meal with a course of dessert. Before serving the dessert the appetite is usually satisfied, but on account of the artistically prepared and deliciously flavored preparation, the extra material is eaten. *The average meal should not afford opportunity for feasting*, but should be prepared and served with the idea simply of supplying bodily needs.

A third cause of overeating is ignorance of what the food requirements of the body really are. On account of this ignorance there is necessarily a blind following of appetite, habit, and the mistaken notion that health is in some way determined by the amount of food which one is able to consume. A lack of appetite should usually be interpreted to mean that the body already has an excess of food and should take no more until this is disposed of. The general custom, however, is to force oneself to eat whenever mealtime arrives unless there is positive revulsion on the part of the stomach.

**The Problem of Obesity.** — Many people are greatly hampered in their activities and have their lives shortened by the abnormal accumulation of fat. The observed differences among people in this regard depend both upon their ability to digest and upon their ability to use up materials after digestion. Some are able to oxidize all the materials entering the blood from the digestive organs; others are not. Because the fat is not so readily oxidized as other materials it is stored for future use. While it seems unfair to say that all fat people overeat,[1] this statement is true in the sense that overeating has been defined. Although the fat person may eat much less than the lean person by his side,[1] he is nevertheless taking food in excess of the needs of his cells. To prevent obesity is essential to continued good health and efficiency, and in this connection it should be stated that it is much easier to prevent fat accumulations than to reduce them after they occur.

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[1] In some instances excess of weight is not due to an excess of fat, but to accumulations of water in the tissues. This condition is indicative of disease and should come under the care of a physician.

## ADJUSTMENT THREE:

### *To adapt foods to a low state of bodily vigor*

Great differences exist among people in their ability to utilize standard varieties of food, and in the same person there may be wide variations from day to day. There arises on this account the necessity for adjusting foods to the bodily condition. One of the simplest of such adjustments is in the matter of quantity.

**Adjustments in Quantity.** — Since this topic was partly covered in the preceding pages, we may limit our discussion of it here. To reduce the amount of food as bodily vigor declines is instinctive. The sick animal eats little, but increases the amount as his condition improves. Knowing that the body becomes less able to use materials as the tone of health declines, the human being finds it at times advisable to use even less than his appetite calls for. On the other hand, there is that constant demand for tissue-building and energy-producing materials which makes it harmful to carry food restriction too far. The aim during periods of depressed vitality, therefore, should be to eat what can be readily assimilated, but not more. At such times the kind of food is also a factor of great importance.

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[1] Strange as it may seem, overeating may just as frequently reduce weight as increase it. If digestion be impaired the excess of material remains in the food canal, where it decomposes, producing toxic compounds which greatly interfere with health. The result in such cases is to reduce the weight.

**Precautions in the Use of Proteins.** — The average individual, following his inclinations and having the means of supplying them, tends to use proteins in excess of his need for tissue-building materials. Although this may be done without special harm, the excess being oxidized for the production of energy, there is formed an unnecessary amount of wastes (urea, uric acid, sulphates, and phosphates), and this renders more difficult the problem of elimination. It becomes necessary, therefore, in cases of impaired chemical and eliminative processes — conditions frequently present among indoor workers and people past middle age — to limit the proteins to the needs of the body for rebuilding tissue, i. e., to one-seventh of the total intake of solid food. In the selection of proteins it may also become necessary to discriminate among the various food materials which supply them.

**Adjustments to Avoid Purin Bodies.** — The purin bodies, so-called, constitute a small class of compounds associated with several important foods, mainly the proteins. They have little or no value either in rebuilding tissue or in supplying energy, but do exercise a stimulating effect and have much to do with our food habits. In composition they are quite similar to uric acid ($C_5H_4N_4O_3$),[1] and when taken into the body change into this compound. Most of the uric acid thus formed oxidizes under normal conditions to urea and carbon dioxide, which are then passed from the body as waste.[1] If bodily vigor is lacking, however, this may fail to occur, in which event more or less of the uric acid remains in the body doing harm. Because of this fact it is frequently of great advantage to avoid foods that contain purin bodies in any but very small amounts.

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[1] The names and the formulas of the better known purin bodies are hypoxanthin ($C_5H_4N_4O$), xanthin ($C_5H_4N_4O_2$), uric acid ($C_5H_4N_4O_3$), guanin ($C_5H_5N_5O$), caffeine ($C_5HN_4O_2(CH_3)_3$), and theobromine ($C_5H_2N_4O_2(CH_3)_2$). The first four are found in lean meat, the fifth in coffee and tea, and the last named in cocoa and chocolate.

**Diet from the Standpoint of Purin Bodies.** — To avoid purin bodies we must know what foods do and what foods do not contain them. The following classes of foods have been found by chemical analysis to contain purin bodies in relatively large amounts:

1. All kinds of meats, though the different kinds vary within small limits. Liver, sweetbread, kidney, and brain, on account of their abundance of so-called nuclear material, have the larger per cents of purin bodies. Fish, white meats, and red meats, show little difference in the amounts which they contain.

2. Vegetables belonging to the legume family — beans, peas, peanuts, etc. — contain considerable amounts of purin bodies. Asparagus and oatmeal also contain them.

3. The table beverages, tea and coffee, and the alcoholic beverages, beer and ale, contain purin bodies. Chocolate contains only a small per cent. The average cup of tea contains about one grain and the average cup of coffee about one and one-half grains.

4. Beef extracts and meat soups and broths of various kinds obtained by boiling meat in water. Being soluble in hot water, the purin bodies are dissolved out by boiling after which they remain in solution. (See Table II.)

Foods comparatively free from purin bodies are milk, cheese, eggs, nuts, white bread, corn bread, butter, rice, potatoes, tapioca, fruits of all kinds, cauliflower, cabbage,

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[1] Hall, *The Purin Bodies.* Howell, *A Text-Book of Physiology.*

TABLE II. QUANTITY OF PURIN BODIES IN CERTAIN FOODS AND BEVERAGES. (Compiled from Hall.)

| | *Grams per kilo* | | *Grams per kilo* | | *Grains per pint* |
|---|---|---|---|---|---|
| Beef | 1.305 | Beans | .637 | Lager beer | 1.07 |
| Salmon | 1.165 | Peameal | .39 | Pale ale | 1.29 |
| Pork | 1.212 | Potatoes | .02 | Porter | 1.37 |
| Liver | 2.752 | Onions | .09 | Coffee | 3.4 |
| Sweetbread | 10.063 | Asparagus | .21 | Ceylon tea | 2.4 |
| Chicken | 1.295 | Oatmeal | .53 | China tea | 1.5 |

lettuce, and in fact most vegetables except asparagus and the members of the legume family as stated above.

*A purin-free diet* is one from which the purin-bearing substances have been excluded. In such a diet the tissue-building materials — the proteins — are obtained chiefly from milk, cheese, eggs, nuts, and white bread, while the carbohydrates and the fats are obtained from the usual sources.

**When a Diet Relatively Free from Purin Bodies is Advisable.** — The value of a diet which is relatively free from purin bodies lies in the fact that it simplifies the chemical work of the body and renders waste removal less difficult. Although there may be no special need for one in vigorous health to confine himself to purin-free substances, such need does exist for those lacking in bodily vigor. The purin bodies may be looked upon as dangerous wastes already present in certain foods before they are eaten. When such foods are used we have not only to throw off the natural wastes that result, but also the additional wastes which they contain. Obviously we lessen the work of elimination by avoiding these foods. The problem, however, is not so simple as it seems, and conditions may exist in individual cases which make too close an adherence to purin-free substances inadvisable.[1]

Everything considered, the purin-free diet may be looked upon as a temporary shift made necessary by impaired chemical and eliminative processes — an adjustment to meet a weakened condition. Hence instead of accepting such a diet as the solution of the problem, one should, while availing himself of its advantages, strive constantly to improve his health, thereby making it possible to use and enjoy a wider range of the good things which people eat.

**Adjustments to Avoid Excess of Acids.** — Physicians recognize the occasional development of a serious condition referred to as *acidosis*, or as *acid auto-intoxication*, in which the various fluids of the body become too much of an acid nature. As a result of this condition there may be irritations of the stomach and intestines, interference with the normal reactions of the body, rheumatic pains, and, according to one authority, serious disease of the kidneys.[2] While there is a decided difference of opinion as to the part played by acids in the causation of disease, sufficient evidence of harmful effects in individual cases has accumulated to make advisable the exercise of care in the avoidance of conditions leading to acidity.

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[1] The objection to a strict adherence to a purin-free diet lies in the small number of protein foods to which one is limited and to the failure of these in some instances to meet bodily requirements. With some, milk and cheese are constipating, and others have trouble in digesting nuts. Eggs in considerable quantities are objectionable on account of their content of sulphur, which, in oxidizing, forms sulphuric acid. Again with certain persons the nourishment which they are able to derive from a limited use of good meat more than offsets the bad effects of the purin bodies thus introduced. There is nothing to be said, however, in favor of the use of tea and coffee, for these, in addition to the purin content, supply no nourishment, unless we take into account the cream and sugar which are usually added. The purin body caffeine is also detrimental to the nervous system.

[2] Martin H. Fisher, *Nephritis*.

Two main causes appear to be responsible for the tendency to acid excess as manifested by certain individuals. These are a general run-down condition of the body, resulting in impairment of the chemical processes, and an overuse of acid-containing and acid-forming substances. While avoidance requires the removal of both causes, proper regulation of diet is of first importance so long as the chemical processes are below normal.

**Acid-containing Substances.** — Fruits are the chief foods belonging to this class, and in this connection we must distinguish between the free acids of fruits and those in combination with the alkali metals. The latter not only do no harm, but tend to produce, when the acid radical is oxidized, an alkaline condition which, within certain limits, is beneficial.[1] It is the free acids, and those partly neutralized, that do harm, and these only when they fail of oxidation. The approved adjustment for fruits is as follows:

Use them freely as long as they cause no irritations of the stomach and intestines and there are no other indications of acid excess. If evidences of harmful effects

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[1] The statement, frequently found in works on dietetics, that fruit acids in oxidizing render the body fluids alkaline, is misleading. This statement has reference to the fruit acids in combination with alkali metals and not to free acids. These latter form carbon dioxide and water by oxidizing and do not form the alkali carbonates which are necessary to alkalinity. The difference is illustrated by the oxidation of citric acid ($H_3C_6H_5O_7$), acid potassium citrate ($HK_2C_6H_5O_7$), and potassium citrate ($K_3C_6H_5O_7$), as shown by the equations

$$2H_3C_6H_5O_7 + 9O_2 = 12CO_2 + 8H_2O,$$
$$2HK_2C_6H_5O_7 + 9O_2 = 2K_2CO_3 + 10CO_2 + 6H_2O, \text{ and}$$
$$2K_3C_6H_5O_7 + 9O_2 = 3K_2CO_3 + 9CO_2 + 5H_2O.$$

Hence if the urine becomes less acid from the use of fruits, it is due to the mineral salts which are in combination with the organic acids and not to the free acids.

appear,[1] however, the fruits should be limited in their use, the well-ripened sub-acid varieties being selected, and if this does not suffice, they should be omitted for the time being. It is best, however, not to omit them entirely if some adjustment can be made to avoid their harmful effects.[2] A plan which some, who are otherwise troubled by fruit acids, are able to follow, is to take the fruits unmixed with other foods, making an occasional meal entirely of fruits, but excluding them from the meals which intervene.

Other acid-containing substances are tomatoes, the foods and condiments (pickles, slaw, etc.) to which acetic acid has been added, and acid drinks, such as lemonade and the sour wines. All these substances, like the fruits, should be used with care and at times avoided altogether.

**Acid-forming Substances.** — These fall into two groups — those which in the regular processes of metabolism form acids and those which produce acids as a result of fermentation or other undesirable chemical changes in digestion. Chief among the members of the first class are the proteins to which reference has already been made. These on account of their content of sulphur form sulphuric acid, and on account of the phosphorus in some of them, form phosphoric acid.[3] The purin bodies associated with some of them form uric acid as already explained. Hence the plan of limiting the proteins to their tissue-building function and of avoiding those rich in purin bodies in order to simplify the problem of waste removal, has the further effect of diminishing any tendency to acid excess. Chief among the substances which, through fermentation, produce acids are the different forms of sugar.

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[1] The evidences of excess of acid include sour stomach, or "heart burn," burning sensations in the intestines, a "sharpened" condition of the teeth, certain forms of mouth sores, and rheumatic pains in the joints and muscles.

[2] On account of the indigestible material (cellulose) which fruits contain, they are an aid in relieving constipation. They also supply a large variety of mineral salts. Their free acids, moreover, have a cleansing effect upon the mucous surfaces, relieving the stomach often of accumulated slime (page 169) and, upon oxidation, yield some energy.

[3] Evidences of the formation of sulphuric acid in the body are found in compounds in the urine containing the radical $SO_4$, such as $HC_6H_5SO_4$. The presence in the urine of this partly neutralized acid is the cause of its acid reaction.

**Sugar and Acid Accumulation.** — A too liberal use of sugar may lead to acid excess in either of two ways: 1. By its use in sweetening acid fruits in order to make them palatable. Sugar so used does not neutralize the acids, but conceals them from the acid sentinel, the sense of taste, thereby letting materials enter which would otherwise be rejected. 2. By the formation of acid through the fermentation of sugar in the stomach and intestines.

Both methods suggest care in the use of sugar. Fruit which is so sour that it must be smuggled into the body by the aid of sugar should not be eaten,[1] and when fermentation results from the use of sugar, it should be omitted until the digestive organs are able to carry on their work in a normal manner. Sugar, including candy, gives least trouble when well mixed with the regular meal and is most likely to ferment when freely used between meals.[2]

**Starch versus Sugar.** — Sugar may be looked upon as predigested starch, since starch in digesting changes to a form of sugar. One might suppose, on this account, that sugar is better adapted to the needs of the body than starch, but such is not the case, especially with adults. It is a part of the body plan of using foods to store considerable starch in the stomach and to admit this *slowly* into the small intestine so that it may be digested only as needed by the tissues. Sugar, requiring little or no digestion, is apt to be absorbed more rapidly from the food canal than it can be used, and in this way to disturb the even supply of material to the cells. Although the body does store up carbohydrate at the liver, changing the sugar into glycogen, its capacity for this work is limited. Hence while sugar taken in small amounts at the regular meal serves a valuable purpose, it is not adapted to use in large amounts as is starch. What is true of sugar is true of any kind of energy or tissue food which requires little or no digestion.

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[1] The disagreeable taste-sensation of sourness is our protection against acids that are so strong or so concentrated as to do harm.

[2] Though sugar is the natural carbohydrate food for infants and small children, much harm results to stomach, teeth, and general health from the unrestrained use of sweets between meals. Once sugar fermentation is set up in the stomach, it is difficult to control. It is better, therefore, that the child up to five or six years be kept happily ignorant of candy, being given its necessary sugar as a part of the regular meals.

### Adjustment Four:

### *To reduce the cost of living*

The engineer takes into account the cost of fuels and when he can accomplish the same results by the use of cheaper grades, he selects these. Much money can likewise be saved through the proper selection and use of foods. Because the money thus saved can be used for other bodily needs, such saving may serve purposes that are truly hygienic. The following are some of the more common ways through which expenditures for foods may be reduced:

1. By simplifying meals, supplying a sufficient amount and variety of food, but avoiding an excess which must be thrown away.

2. By the slow and thorough mastication of food. Since food which is thoroughly and slowly masticated is more perfectly digested, less will be required.

3. By the avoidance of overeating.

4. By the substitution of cheap foods for the more expensive varieties containing the same nutrients.

The greatest saving is usually accomplished through the last-named means. By a study of Table I (page 127), it will be seen that food materials varying greatly in price often contain practically the same nutrients.

**The Use of Cornmeal instead of Wheat Flour.** — Cornmeal is perhaps the cheapest of all our foods. Although the nutrients in corn are not considered a complete substitute for those in wheat, the corn containing a smaller per cent of protein and this being a less valuable form, it is possible for the average family to make a much larger use of corn bread, hominy, mush, and other corn preparations, than it does now. Indeed, a certain amount of these is especially desirable on account of their effect upon the movement of materials through the food canal (page 179).

**Substitutes for Butter.** — While butter is the most valuable of the fats for food, it is also the most expensive. Hence considerable may be saved by substituting fat meat, and gravies prepared from fat meat, for butter, provided these can be as easily digested. Oleomargarine, or butterine, prepared from beef suet with the addition of a small amount of butter, is similar to the dairy product in all essential respects and serves as an economical substitute for this food.[1]

**Substitutes for Tea and Coffee.** — A considerable sum may be saved by the average family through the omission of tea and coffee, and this omission, as already suggested, may serve an additional purpose in simplifying the problem of keeping well. The approved substitute for these beverages is pure, cold water, and when one gets habituated to the change he desires nothing better. If in discarding tea and coffee, one craves a hot drink, he may temporarily use hot water seasoned with a little milk and sugar. The sooner, however, he depends upon nature's beverage served in the natural way, the more will he appreciate it, provided his habits are in other respects normal.

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[1] It is a fact, however, that the fats contained in oleomargarine differ to some extent from those in butter, and this may make some difference in the readiness with which it digests.

**Substitutes for Meat.** — Whether one limits his consumption of meat for purposes of health[1] or for the sake of economy, he must find suitable substitutes for it. This is chiefly a matter of selecting materials rich in protein and which at the same time are readily digested and assimilated. Two of the most valuable of such substitutes are milk and the coagulated protein from milk, or cheese. Milk alone is too dilute for supplying the bodily need for protein, but when combined with white bread is sufficient. For the average evening meal nothing is better than bread and milk.

Eggs are good substitutes for meat, but should be used sparingly for the reason already stated (footnote, page 134). Nuts replace meat and if easily digested are good substitutes. Almonds, pecans, English walnuts, and also our common walnuts and hickory nuts contain a large percentage of protein. For cheapness, however, beans, peas, peanuts,[2] and the other members of the legume family are the most desirable of the meat substitutes, although their small content of purin bodies makes them less hygienic than the foods mentioned above.

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[1] Upon the advisability of omitting meat entirely from the dietary there is a decided difference of opinion among authorities. The fact that the strong nations of the earth use much meat and the weak ones little meat would suggest that there is some special food value in meat not supplied by other protein foods. Granted that such a value exists (which is improbable), the amount necessary can be supplied by using meat sparingly — two or three times a week and in small amounts — and avoiding the expensive and harmful excess.

[2] In eating peanuts the thin skin surrounding the kernel should be removed. While this may not be poisonous, as some suppose, its bitter taste detracts greatly from the palatability of this valuable legume.

**Summary.** — The constantly varying needs of people, as well as the ever-changing conditions of modern life, require frequent and sometimes radical departures from the instinctive methods of taking food. The food adjustments considered in the present chapter may be grouped under the following heads:

1. Adjustments whereby tissue-building foods and energy foods are admitted to the body in correct proportions and in desirable amounts and the body obtains all the different kinds of chemical elements which it needs.
2. Adjustments to avoid excess of wastes and the production of materials injurious to the cells.
3. Adjustments to meet a lowered condition of bodily vigor and impairment of the chemical processes.
4. Adjustments to reduce the cost of living.

In making adjustments of real advantage, both knowledge and care are necessary. One cannot go far in the scientific use of foods without understanding bodily needs and the combinations of foods that best supply them. The conditions which make special adjustments desirable must also be understood, as well as the means by which the bodily condition may be so improved that special adjustments are no longer necessary. A further adjustment in foods is considered in the chapter following.

**Exercises.** — 1. In what respects do foods resemble fuels? In what respects do they differ?

2. Compare the instinctive, or animal, mode of eating with the rational mode.

3. Name the different classes of foods and the purposes which they serve.

4. If proteins serve the double purpose of rebuilding tissue

and supplying energy, why is it advisable to limit their consumption to the first purpose?

5. Name three foods rich in tissue-building material; three energy foods. Of what practical value is a food table, such as the one on page 127?

6. Give three uses of water in the body. How much is needed and when should this be taken? Why should we drink some water during meals?

7. Why are overeating and underfeeding both unhygienic? Which practice is the most common, and why?

8. Upon what does the quantity of food depend? Define overeating. What are the usual causes?

9. How may the appetite be used as a reliable guide in determining the amount of food?

10. What purposes are served by the mineral salts? What adjustments in food are necessary for securing these in sufficient variety?

11. State the causes of obesity. Why does overeating increase the weight of some and diminish the weight of others?

12. What are purin bodies? What foods contain them? Under what conditions do they do harm?

13. In what does a purin-free diet consist? When does such a diet become necessary? What classes of people should incline their diet toward purin-free substances?

14. Under what conditions must acid-containing and acid-producing substances be used with care?

15. Why is starch better adapted to the use of the body than sugar? Under what conditions must sugar be used sparingly? State the objections to predigested foods.

16. By what different means is money saved through the intelligent use of foods?

17. Compare the merits of eggs, milk, cheese, nuts, and beans, as substitutes for meat.

## Health Work

**Habit IV.** — *Of food adjustments.* Select and use foods upon the basis of bodily needs and bodily conditions, rather than upon the basis of custom, appetite, or habit.

The fact that eating is a source of pleasure often causes one to select foods from the standpoint of palatability, rather than from the standpoint of what is best for the body. It is largely from the gratification of misdirected and overstimulated appetite that errors in diet are committed, and it is by purposeful and intelligent control of appetite that harm is avoided. We must assume *the scientific attitude*, and this is expressed by the saying that we "eat to live and do not live to eat." Appetite is to be followed as far as it shows itself to be a true guide, but it must be controlled and directed when it fails to express the actual needs of the body. It is true, moreover, that as we "eat to live" we have a much better chance of "living to eat."

Fortunately the appetite may be trained, and it is by no means difficult to develop a desire for the things that do us most good. If we have been victims of improper food habits, the first step is to begin the enforcement of necessary restraints. As we resist day by day the temptation to depart from the course we have laid out, the task becomes easier and finally we arrive at a condition such that we experience as much pleasure from foods that make for health and efficiency as we formerly experienced from the rich and highly seasoned dishes that gave trouble.

**To Reduce Weight.** — The individual who accumulates fat to an abnormal degree usually possesses an appetite and an ability to digest which are in excess of his needs. As a result he unguardedly takes in more than he uses. The natural method of reducing flesh is to diminish the amount of food and, at the same time, increase the physical exercise. Exercise before breakfast has been found highly beneficial for this purpose. The chief difficulty experienced is usually in the control of the appetite — a condition absolutely essential to success. Attention must also be given to the kinds of food eaten, avoiding an excess of starch, sugar, and fats. Unless there be a decided tendency to constipation it is best to limit the quantity of water. The weight should be frequently taken to see what is being accomplished (Fig. 32). Success depends upon the degree of determination and persistence brought to bear upon the problem. Drugs which reduce the weight usually do so by injury to the health and should be avoided.

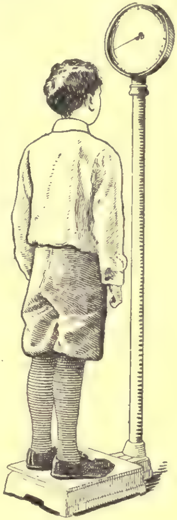

FIG. 32.— **A Convenient Scale** for school purposes.

**To Control Acidity.** — Although authorities do not agree as to the extent to which health may be injured by excess of acids, it is highly desirable that possible dangers from this source be avoided. The essential points to be observed are the following:

1. Through physical exercise and other means keep up bodily vigor. This enables the organic acids to be disposed of through the natural method of oxidation.

2. When bodily vigor is low, one should exercise care in the use of fruits and other acid-containing foods. He should first try the plan of using them unmixed with other foods. If they still cause trouble, he should omit them for the time being.

3. A further adjustment when bodily vigor is low is to limit proteins to the amount needed for rebuilding tissue, omitting those rich in purin bodies, and to use vegetables freely on account of the neutralizing effects of their mineral salts.

4. Use sugar with care, diminishing the amount as acidity occurs or as evidences of fermentation are observed.

5. To a limited extent one may use alkaline mineral waters and weak solutions of cooking soda for neutralizing acids, though there will be slight occasion for neutralization if the above suggestions are carried out. A half-teaspoonfool of cooking soda in a tumbler of water taken half an hour before mealtime when there are indications of acid excess will do no harm, but may prove a positive aid in maintaining the normal reactions of the body. Care should be exercised, however, that the "soda habit," which many have to their detriment, be not formed.

6. Improve the digestion as explained in the chapter following. Often the trouble entirely disappears as the digestion improves.

**To Show that Sugar Does not Destroy Acid.** — Place 5 cc. of lemon juice in a small vessel and dilute with water. Taste it and test it with litmus papers. Now add sugar, dissolving this by heating until the solution is perfectly sweet to the taste. Test again with litmus papers, noting the result.

**To Discover Acids that are Concealed.** — Many substances which are decidedly sweet to the taste contain acids and would be sour if it were not for the sugar. Such substances are easily tested with litmus papers. Make solutions of molasses, the thick syrup from canned fruit, and different kinds of candies, and test these with litmus for the presence of acids. Acids turn blue litmus red.

**To Determine Calories.** — In some instances it is desirable to know the energy equivalent of the food consumed. To secure this information a record of the weight of each article eaten is made for a certain period — a day or longer — and the calories computed on the basis of the heat units as shown in Table I. For example, if two ounces of butter ($\frac{1}{8}$ lb.) are consumed in a day, the energy equivalent is equal to $3515 \times \frac{1}{8}$, or 440 calories.

# CHAPTER VIII

## CONTROL THROUGH THE AVOIDANCE OF HARMFUL SUBSTANCES

"O God, that men should put an enemy in their mouths to steal away their brains!" — *Othello.*

So simple and natural are the acts of eating and drinking that we seldom consider the serious consequences that may result from eating or drinking the wrong substances. The mouth is the main gateway to the body, and while it is guarded by the senses of taste, smell, and sight, these are subservient in the human being to a higher authority — the intelligence. This authority must determine what substances shall and what shall not pass the body gateway.

Substances are unfit for entrance if they are partly decayed or bear the germs of disease, if they contain harmful preservatives or adulterants, or if they are naturally harmful. Of our regular food supplies, the greatest liability to injury is perhaps attendant upon the use of meats.

**Dangers from Meats.** — Meats become dangerous to the health and life even, under the following circumstances:

1. When from exposure to bacteria, warmth, and moisture, they are permitted to decay. Decayed meats are harmful on account of the germs which they contain and the toxins, or poisons, which the germs secrete, and also because of harmful substances produced through putrefactive changes.

2. When they are obtained from the carcasses of animals having diseases which are communicable to man. The disease known as trichinosis, in which small, spiral worms become encysted in the muscles, is communicated to human beings by the raw or partly cooked meat of diseased hogs, and by a similar process, the different kinds of tapeworm larvae (pork, beef, and fish) find their way into the human intestines.[1] It is possible also that meat from tubercular cattle may transfer the bacilli to man.

3. From the adherence of germs obtained through uncleanly methods of slaughtering, transporting, and marketing meats. Fecal matter may be easily picked up in slaughtering, and the swarms of flies at the abattoir and the market place may add the germs of typhoid or other diseases.

4. From oysters grown in waters containing sewerage or "fattened" in fresh water polluted by human waste.[2] Such oysters are frequently the means of spreading typhoid fever and cholera.

**Precautions Relative to Meats.** — The sources of meat dangers suggest certain fundamental precautions, as follows:

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[1] Man, in turn, is responsible for the presence of the tapeworm larvæ in the lower animals. In the human intestines the worms produce immense numbers of eggs which pass out with the feces. Fish obtain these through the pollution of streams, and hogs and cattle by the contamination of their food through contact with human fecal matter. The eggs, hatching in the intestines of these animals, form tiny worms which penetrate their walls and become encysted in the muscles. These facts suggest the importance of care in the disposal of waste from the human body.

[2] It is a custom of the oystermen to place their product for a few days in fresh water before putting it on the market. By a process of osmosis, the oysters take up water and increase in bulk, or "fatten." While this in itself does no harm, the oysters may, if placed in polluted water, absorb the germs of disease.

1. Meats known to be spoiled or contaminated should be rejected.

2. Every kind of meat should be thoroughly cooked before serving. If the cooking is sufficient for the penetration of high temperature to all parts, the living germs are killed, the putrefactive poisons and the germ toxins are decomposed to a considerable extent, and the encysted larvæ of trichinæ and tapeworm are disintegrated. If the meat is only surface cooked, these results are not accomplished.

3. The abattoir, or slaughterhouse, should be clean and sanitary in all respects.

4. Uncooked meats should be kept in cold storage or upon ice.

5. The market should be screened from flies and kept scrupulously clean, while the hands, clothing, and tools of the butcher "should have a cleanness approaching that of the surgeon."

6. The carcasses of all kinds of diseased animals should be excluded from the food supply.

7. Oysters from polluted water should be excluded from the market.

**Dangers from Milk.** — Milk is the most important and the most easily contaminated of all our foods. It is a perfect culture for several varieties of dangerous germs and the readiness with which it spoils frequently causes dealers to contaminate it with harmful preservatives. The germs of typhoid fever, scarlet fever, diphtheria, and tuberculosis, are very frequently distributed by milk. Milk may become unfit for use from any of the following causes:

1. By an unclean condition of the cow, especially of the milk bag, which results in impurities being dropped

into the milk pail. Much of such filth is cow manure and contains, when from tuberculous cattle, germs which may cause tuberculosis in man (footnote, page 356). Dirty milk is the chief means through which bovine tuberculosis is communicated to human beings.

2. By impurities from the hands and clothing of careless workmen who collect and handle the milk.

3. By flies which transfer all kinds of filth from places where they feed to the milk pails and bottles. This seems to be the most important of the methods by which the germs of typhoid fever get into milk.

4. By poisonous agents, most frequently formaldehyde, which are added to the milk to prevent souring.

5. By impure water added to the milk to increase its volume, and by coloring matter, to give a creamy appearance.

The problem of supplying pure milk is solved by keeping only healthy animals in the herd, by the exercise of scrupulous cleanliness in handling and feeding the animals and in milking, by cooling the freshly drawn milk to 50° F., and by storing it in sterilized, closed vessels until delivered. When these precautions are observed, it will reach the consumer in a wholesome condition, provided it is delivered not later than twenty-four hours after collection. Milk which is questionable should either be boiled or Pasteurized (page 326).

"Certified milk" is milk of the highest quality obtained under the conditions described above and approved by a medical milk committee appointed to inspect and supervise the methods of the dairymen. The richness and purity of such milk more than compensates for the higher price.

**Purity of Eggs.** — Eggs are less liable to convey disease or to contain harmful products than any other animal food. However, there are essential differences between eggs that are spoiled, or half-spoiled, and those that are fresh. By a careful method of inspection, called candling (Health Work section), it is easy to detect eggs that are not of the first quality.

**Poisoning from Plant Foods.** — The more important of the ways by which people become diseased or are poisoned through plant foods, are the following:

1. By contamination of these foods from the soil. Soils fertilized with fresh manure from the barnyard may contain dangerous germs. Manures containing human excrement are especially dangerous and should not be used unless thoroughly disinfected (pages 372 and 374) or until they have completely decomposed.

2. By faulty methods of transporting and marketing plant foods. Exposed to flies, dust, or dirty hands, they are very apt to become contaminated.

3. By dangerous substances resulting from decomposition or other causes. Carbohydrates in fermenting produce alcohol, acetic acid, and other substances, some of which are harmful, others not. "Ptomain" poisons result from the decay of proteins, especially those in meats. Potatoes, which during growth are exposed to the sun, develop a substance, called *solanin*, that may cause serious bodily disturbances. This poison also develops in sprouting potatoes.

4. By the use of poisonous plants which resemble plants suitable for food. The most common instance of poisoning from this cause is the mistaking of poisonous mushrooms for those that are edible. When there is the least doubt about the variety of mushrooms they should be soaked for some time in water acidulated with vinegar and then rinsed in fresh water. The water by dissolving out the poison will prevent serious results.

5. By the use of unripe fruits. These are liable to contain harmful substances which disappear in the ripening process.

The causes which operate to produce ill effects from the use of plant foods suggest the appropriate remedies for preventing them.

**Community Regulation of Food Supply.** — Only through efforts directed by the community as a whole can the contamination, adulteration, and doctoring with harmful chemical agents, of the food supply be prevented. This does not mean that people generally are unreliable and dishonest, but that the consumers are, as a rule, so remote from those who produce and transport foods, that the feeling of personal responsibility which is manifest in direct dealing usually does not exist. In the passage of the pure food laws by our national and state governments, a long step has been taken in the protection of the consumer. Much remains to be done, however, in the enforcement of these laws and in adapting them to existing needs and conditions.

**Alcoholic Beverages.** — It would be strange indeed if during the long period that man was guided by his unaided senses (smell, taste, and resulting bodily feelings) in the selection of foods, he had not made some mistakes — if he had not accepted substances as foods which, on trial through long periods, should prove detrimental. That such a mistake was made in the use of alcoholic beverages is now known beyond question, though many years of such usage have been necessary to demonstrate this fact.

In the early history of the race it was discovered that a pleasantly flavored, stimulating liquid resulted when fruit juices were permitted to ferment. This weak alcoholic solution, or "wine," came into very general use in early times as a medicine, as a beverage at feasts and celebrations, and to some extent as a food. Though harmful effects were observed when it was used to excess, the limited amounts which could be obtained through the primitive methods of manufacture and storage, prevented the bad effects from becoming general.

The discoveries which made general alcoholic excess possible did not occur until about the eleventh century. At that time our present method of forming alcohol through the fermentation of starch-containing substances, such as wheat, rye, potatoes, etc., became known. About the same time distillation was discovered and this made possible the separation of "the spirit of wine," or alcohol, from fermenting substances, and the concentration of weak alcoholic solutions. As a result of these discoveries alcoholic beverages began to be produced in great abundance and variety, and alcoholic indulgence, which had been the pastime of the few, became the privilege of all.

On account of the profits derived by the manufacture, distribution, and sale of alcoholic beverages, many people became interested in them from commercial reasons. These, because of business interests, were active agents both in defending such beverages and in the initiation of the rising generation into their use. As a consequence, the struggle against alcohol which began as its evil effects were discovered, has not been simply an effort to induce people to abandon its use, but more specifically a conflict between the better elements of society and gigantic business enterprises founded upon alcohol (page 415).

**Alcohol not a Food.** — Through the researches of Atwater and others it has been shown that alcohol can, like sugar and fat, be oxidized in the body to set free energy, and upon this basis it has been classified by some authorities as a food. A comparison of the metabolism of alcohol with that of the other energy foods, however, shows that this classification is erroneous. Through well-defined methods, the body is able to admit carbohydrates and fats to the blood and distribute them to the cells as its needs for energy require. But because the body has no method of storing alcohol and of supplying it gradually to the cells, its metabolism cannot be so controlled. Requiring no digestion, it quickly enters the blood, and from the blood it passes to the cells, — whether they need it or not, — at least until the excretory organs throw off the excess as waste.

The chemical transformations and physical deportment of carbohydrates and fats in the body show a marked contrast to those of alcohol. On being eaten they are first stored in the stomach, where they await digestion. As digestion gradually occurs, they pass into the blood, but even then any slight excess is taken from the blood and stored (the carbohydrates by the liver and the fat by the connective tissue) until needed by the cells. There is thus supplied *a method of regulating the consumption of energy foods* analogous to the regulating devices upon stoves and furnaces. Because alcohol lacks the physical and chemical properties which would enable it to be so regulated, it cannot be properly classed as a food.[1]

**Why Alcohol should be Omitted.** — Partly because alcohol is not adapted to the body plan of using energy materials and partly because of its active chemical nature, it does harm in a number of ways. It acts as an irritant to mucous linings and interferes with the digestive processes.[1] It injures the cells of the liver, kidneys, blood vessels, and brain, and is a predisposing cause of all diseases resulting from impaired metabolism. It injures the general nervous system, and with some it develops a tendency to obesity. It lowers the bodily resistance, and by so doing renders one more susceptible to diseases caused by germs. Being a habit-forming substance, alcoholic usage is likely, indeed almost certain, to be continued after the harmful effects have become apparent.

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[1] See *Physiology and Hygiene*, page 181.

Although the harm wrought through alcoholic beverages varies with the individual, the amounts consumed, the special beverages employed,[2] and other conditions, the evidence is conclusive that alcohol in any form and in very small amounts renders more difficult the problem of health control.[3] Hence one who is seeking the greatest efficiency from day to day and is also planning for future health and efficiency, will carefully avoid this substance.

**Avoidance of Tea and Coffee.** — Another possible mistake in the introduction of materials into the body has been the adoption of beverages prepared from plants containing stimulating agents, tea and coffee being the ones most commonly used. These substances, as already stated, contain the purin body, caffeine, whose introduction renders more difficult the processes of metabolism. This drug also irritates and excites the nervous system and is, under certain conditions (page 238), a potent cause of nervous waste. Although tea and coffee are not to be classified with alcohol in their pernicious effect upon the body, they serve no purpose beyond the apparent necessity of keeping up a habit once formed, and they render the problem of health maintenance more difficult. While many people use tea and coffee without apparent harm, it is especially desirable that the following classes refrain altogether from the use of these beverages:

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[1] While this effect is greatly diminished by taking alcoholic beverages only during or immediately following meals, it cannot be wholly avoided except in the use of the smallest amounts.

[2] The percentages of alcohol contained by the various beverages are as follows: Malt liquors, such as beer and ale, contain from three to eight per cent. Wines, such as claret, hock, sherry, and champagne, contain from five to twenty per cent. Distilled liquors, such as whiskey, brandy, rum, and gin, contain from thirty to sixty-five per cent.

[3] A possible exception to this statement is found in the use of alcohol by the physician in the cure of disease. When its administration is carefully guarded and it is discontinued as soon as the need for medicine has been removed, it is no more objectionable than other drugs. The well-trained physician, however, is in no way dependent upon alcohol for securing the best results in his practice.

1. Children and young people. Any kind of harmful substance does most harm during the years of development.
2. Those suffering from diseases resulting from impaired metabolism or in whom there are evidences of disease encroachment due to this cause.
3. Those suffering from either mild or serious disorders of the nervous system.
4. Those who spend much time indoors and take little exercise.

**Avoidance of Tobacco.** — Although tobacco is not considered in any sense a food, both chewing and smoking have for their purpose the introduction of a powerful drug (nicotine) into the body. This is absorbed through the mucous linings of the mouth and air passages in sufficient amounts to affect the nervous system, stimulating some but acting in general as a narcotic. While the effects of nicotine vary with the individual, it is in general harmful, and there can be no doubt but that the health of all would be on a sounder basis if the use of tobacco were entirely discontinued. Its deleterious effects upon physical and mental development are especially marked, there being numerous instances in which boys have been stunted both in body and mind from nicotine poisoning. Under no condition should the use of tobacco be taken up before one has reached the age of maturity.

**Drugs in General.** — A drug is a substance which has very little or no value in the production of energy or the rebuilding of tissue, but which is taken to produce some effect upon the nervous system or to influence in some manner the chemical work of the body. The unanswerable argument for the use of drugs by the physician is the fact that the body processes are essentially chemical in nature and can, on this account, be modified through chemical agents. This fact also affords argument against the administration of drugs by those who do not understand the fundamentals of physiological chemistry and the effects which the drugs produce upon the body processes, and against the methods of the patent medicine industry as carried on in this country. What are the chances of causing desired chemical reactions in the body laboratory when one, with no other guide than his symptoms and the patent medicine advertisement, selects and takes some of these drug mixtures?

There is abuse sometimes in the use of drugs, even as administered by the physician. Drugs should not be taken when the same results can be attained through hygienic means, and strong medicines should not be given when mild ones will accomplish the desired ends. Since it is very difficult to produce desired results with drugs without producing at the same time effects that are undesirable, the general plan of taking as little medicine as possible should be followed.

**Drugs and the Automatic Mechanism of Control.** — A chief objection to the use of many drugs is their habit-forming tendency. By using them voluntarily through a given period, varying with the individual and the drug, a condition is developed in the nervous system which engrafts their usage upon the automatic mechanism of control (page 36). When the so-called habit[1] is formed, a craving more or less severe is experienced if one fails to take enough of the drug to keep his system "charged." As a result he uses the substance continuously and as a matter of course. He is no longer a free agent in deciding whether the substance in question should be introduced into the body, for with the formation of the habit *he has surrendered his freedom of choice.* Then along with the change in his mental attitude, and to a considerable degree responsible for it, has come a profound change in his instinctive method of control. This last effect is strikingly illustrated in the development of

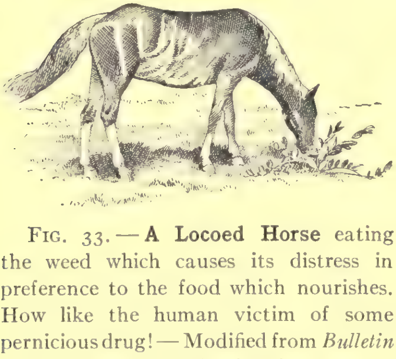

FIG. 33. — **A Locoed Horse** eating the weed which causes its distress in preference to the food which nourishes. How like the human victim of some pernicious drug! — Modified from *Bulletin 112* of Bureau of Animal Industry, U. S. Department of Agriculture.

**The Loco Disease in Lower Animals.** — In the pastures of several of our western states there grows a peculiar and rather interesting plant, known as the loco weed. The effects of this weed upon the cattle, sheep, and horses that feed upon it is to develop a craving that causes them to use it in preference to their natural food (Fig. 33) and in spite of the fact that its use is attended by the most serious results.[1] The "locoed" animal soon loses its relish for grass and the other foods to which it has been accustomed, and cases have been reported of poisoned animals that spent the entire day searching the pastures for the harmful weed. On account of this strange perversion of the instinctive mechanism for supplying food, the loco victim must sooner or later give up its life.

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[1] The drug does not produce a habit in the true sense, but develops a weakness of the nervous system which causes a feeling of discomfort when the stimulating presence of the drug is withdrawn. Knowledge that the drug relieves the uncomfortable feeling, rather than habit, is the cause of its continued use.

**Freedom of Choice in Health Control.** — In the same manner the habit-forming drug perverts the natural method of introducing materials into the human body. Although the appetite continues to call for different varieties of food, it calls loudest for the harmful drug. And while one using a liquid drug does not lose entirely his thirst for water, his strongest thirst is for the special drink which contains the habit-forming substance. Even if no greater harm is done than to pervert the natural appetite, this should be a matter of regret. Whether the substance does or does not directly injure the health is really not the main question. *The essential point is that we be unhampered by drug habits in determining what shall and what shall not be admitted into the body.*

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[1] The locoed animal is irregular in its movements, dragging its feet in walking, and stepping unusually high in passing over small obstacles. In going over a rut it leaps as in jumping a ditch. It lacks generally in muscular coördination and shies violently at the smallest objects. A locoed horse is, on this account, dangerous both for riding and driving. While the diseased animal manifests symptoms of extreme nervousness during the first stage, it later becomes dull and listless, taking little interest in anything. Loss of appetite is a marked symptom and from lack of food there is toward the last extreme emaciation. See *Bulletin 112* of Bureau of Animal Industry, U. S. Department of Agriculture, prepared by C. Dwight Marsh.

**Summary.** — To guard the body against all the harmful substances that may enter through the mouth requires the exercise of an unusual degree of intelligence. Difficulty arises not only with the substances of recognized harmful properties but also with those in which the harmful properties are more or less concealed. In the latter class are found:

1. Preservatives and adulterants — substances associated with and a part of standard food materials.

2. Foods in the true sense, but rendered unfit for use through improper methods of production and handling.

3. Substances resembling foods, but of such a nature as to injure the body.

4. Stimulants and narcotics which produce temporary pleasing effects, but which harm the nervous system.

5. Drugs and medicines which cure disease but which, if improperly administered, cause disease.

6. Substances which so impress the nervous system as to render less effective the automatic mechanism of control.

To prevent the entrance of some of these we must oppose social customs and even the persuasive influence of friends. Hence, while exercising due vigilance, we must be equipped with knowledge and dominated by a high ideal respecting bodily health and efficiency.

**Exercises.** — 1. By what different means is the body guarded against the entrance of harmful substances at the mouth?

2. What is the necessity for an intelligent and vigilant guard at this entrance?

3. Enumerate the means through which meat becomes unfit for use. Do the usual methods of cooking remove all the dangers from meat?

4. In what different ways does milk become dangerous to the health? How is it obtained in a pure state? What is meant by "certified milk"?

5. How do dangers from plant foods arise? How are these avoided?

6. Why is the guarding of the food supply largely a duty of the community?

7. Why is alcohol improperly classed as a food? Why is its use even in small amounts a dangerous practice?

8. Why are the evils accomplished through alcohol more pronounced now than in the early history of the race?

9. In what ways is the problem of health control rendered more difficult through the use of coffee, tea, alcohol, or tobacco? Why must young people, especially, avoid these substances?

10. Define the scientific use of drugs. Give illustrations of their unscientific use. What harm arises from the too free use of medicines?

11. How does the formation of drug habits interfere with the automatic mechanism of control? Illustrate.

## Health Work

The establishment of Habit IV, as defined in the preceding chapter, depends upon keeping the body in such a condition that one is free to determine what substances shall and what substances shall not enter the body. This condition is in turn dependent upon a general habit or mode of life.

**Habit V.** *Of Alimentary Control.* Keep the body entirely free from the effects of any and all kinds of habit-forming drugs.

As the true American loves his political liberty, so should he appreciate that condition of his nervous system which enables him to exercise perfect freedom of choice in admitting substances to his body. If he decides that tea, coffee, tobacco, or alcohol would better be omitted, he should be in such control of himself as to encounter no difficulty in excluding them. To the extent that he has acquired the habit of using any of these, he will be lacking in such control. Young people having such habits *should declare their independence of drugs* and begin at once the fight for freedom. Whether this fight be difficult or not depends upon several conditions, but chiefly upon the length of time during which the substance has been used. The following rules, if carefully followed, will enable the young person to win out easily:

1. Have the mind thoroughly made up to stop; be determined to succeed.

2. Live as hygienically as possible, keeping body and mind occupied.

3. Avoid temptation, shunning the company of those who use the same drug.

4. In moments of temptation, indulge in vigorous exercise; if the head aches, sleep if possible. *Never give up!*

5. Conserve the nervous energy (Chapter XII), taking more than the usual amount of sleep and avoiding all kinds of nervous strain.

**To Detect Formaldehyde in Milk.** — Formaldehyde is the most dangerous and most frequently used of the milk preservatives. It is easily detected by the following method: Place 10 cc. of the suspected milk in a test tube and dilute with an equal amount of water. Slant the tube to one side and pour in slowly from 5 to 10 cc. of concentrated sulphuric acid. On account of its weight the sulphuric acid forms a layer below the milk. If formaldehyde is not present the layer will simply be brownish or yellow. If the formaldehyde is present a rather faint rose-tinted or purplish layer slowly forms where the milk and acid meet (Fig. 34).

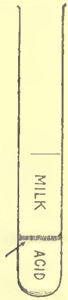

Fig. 34. — **To Test Formaldedehyde in Milk.** A faint rose-tinted or purplish layer immediately below the wide brownish or yellowish layer shows the presence of formaldehyde.

**To Detect Spoiled Meat.** — Meat that is decomposed, putrid, or offensive to the sense of smell should not be eaten. Meat inspectors usually condemn meat which fails to show a red, fresh appearance and from which exudes on pressure a fluid of abnormal color or of alkaline reaction. Meat should be condemned if the fat is not yellow and firm and if the marrow of the bones is not firm and rose colored.

**To Detect Spoiled Canned Goods.** — Cans with bulging ends should always be rejected as this condition is brought about by the formation of gas from the decay of the contents. Sometimes, however, such cans are punctured to let out the gas and the opening soldered up again and the can relabeled. Canned foods which state on their labels that they contain preservatives should be condemned, not so much on account of the small amounts of the preservative as on account of the inferior quality of the goods which make a preservative necessary. To avoid poisoning from tin, the opened can must be emptied at once into a clean porcelain or granite vessel.

**To Candle Eggs.** — A round opening large enough to receive the end of an egg is made in the side of a small box, and just back of the opening is placed a strong light, preferably an electric light bulb. The testing is done in a dark room with the top of the box covered. The egg to be tested has first one end and then the other placed at the opening, while the operator looks for black spots or cloudy places in the otherwise clear field. All eggs are rejected which do not show a clear and uniform field.

## CHAPTER IX

## CONTROL THROUGH AGENCIES THAT AFFECT THE EFFICIENCY OF THE DIGESTIVE ORGANS

We come now to our third great problem in securing normal metabolism — that of maintaining efficiency on the part of the digestive organs. These organs digest (break up and dissolve) our foods; they provide absorbing surfaces for passing these into the blood; they store up foods awaiting the digesting and absorbing processes; and they collect the undigested material and at periodic intervals pass this, with wastes secreted by glands, from the body. The nature and condition of substances reaching the cells must depend largely upon the success of these activities.

**Care of the Mouth.** — According to recent investigations, several important hygienic purposes are secured through proper care of the first division of the food canal — the mouth. By preventing decay of the teeth, more thorough mastication of the food is secured, and as a consequence more complete digestion is obtained. By avoiding irritations of the gums and the teeth, a pronounced cause of nervous disorders (page 248) is removed. And by keeping all parts of the mouth clean and healthy, an important means of contracting and spreading the germs of disease is avoided. Mouth hygiene centers particularly around the teeth, and for their normal development and preservation the efforts of the individual must be supplemented by the skill of the dentist. (See Health Work section.)

Childhood and early youth being the time when expert attention to the mouth is most imperative, the opinion is quite general among educators that free dental inspection should be provided in our public schools. Mouth hygiene, however, is closely related to the hygiene of the entire digestive system, being much simplified when the digestive processes are in all respects normal.

**Digestion a Chemical Process.** — The student of chemistry knows to what an extent care must be employed in all kinds of chemical work (Fig. 35). No matter how simple the experiment, the expected results are not obtained unless the conditions governing them are supplied. If there is carelessness in the use of reagents, a lack of clean apparatus, too much or too little heat, the experiment fails. Success in the performance of the great chemical process, known as digestion, depends no less upon the fulfilment of necessary conditions. If these are overlooked, the process is carried on imperfectly — it may be with harmful results. While successful digestion depends indirectly upon many conditions, these bear for the most part upon two essential requirements:

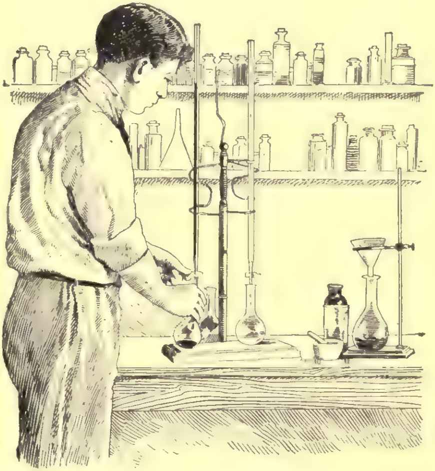

Fig. 35. — **A Chemical Experiment.** Suggestive of an important chemical process which everyone should know how to carry on successfully.

1. The secretion of digestive fluids of a desirable quality and in sufficient amounts.

2. The maintenance of a healthy and clean condition of the food canal.

**Office of the Digestive Fluids.** — The conversion of the solid foods to a liquid form is accomplished through the juices secreted by the various glands. These consist largely of water, the dissolving agent, but each, with the exception of the bile, contains one or more active constituents, called *enzymes*. The enzymes change the food chemically, converting the insoluble proteins, fats, and starch into soluble substances, such as peptone, sugar, and glycerine. The efficiency of the digestive processes must, therefore, depend upon the nature and quantity of the digestive fluids, and these in turn upon the health and activity of the glands which supply them. Hence in order to secure the fluids necessary for digestion we must give heed to the conditions that invigorate the digestive glands and call them into action.

**Conditions Affecting the Activity of Digestive Glands.** — Recent investigations and experiments have shown conclusively that the quantity of juices secreted has a direct relation to the manner of eating and the condition of the person at the time of eating. For obtaining the maximum flow of digestive fluids, the following conditions must be observed:

1. Hunger at the time of eating.

2. Thorough chewing and appreciation of the taste of food.

3. The use of foods that require chewing and the moistening effects of saliva.[1]

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[1] Toasted bread digests more readily than the untoasted mainly because its dry and hardened condition makes it a better gland stimulus.

4. The giving of sufficient time to the meal.

5. An agreeable state of mind and enjoyment of food and the process of eating.

Conditions which, if present, diminish the quantity of juices are:

1. Eating before there is any desire for food, i. e., without appetite or hunger.

2. Rapid eating, imperfect mastication, and inappreciation of the taste of food.

3. The use of foods that are wet and soft and that require little chewing.

4. A morbid, tense, or unhappy state of mind during meals.

These conditions are all subject to control.

**Effect of Hunger.** — Hunger supplies the most important of all the stimuli to the glands of digestion, and "appetite" was recognized as the "best sauce" long before the search for the laws of dietetics had begun. Our methods of eating frequently call us to the table when we are not hungry and when there is apparently no demand on the part of the body for food. To eat under such circumstances is sometimes to attempt the impossible — that of digesting food without a sufficient amount of the digestive fluids.[1] If the exigencies of the occasion force us to take food before there is an expressed demand for it through appetite, we should eat lightly, taking only what may be necessary to "tide over" until the next meal.

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[1] Sometimes from illness or from exhaustion, a real need for food exists without an indication of such through the appetite. At such times the taking of some savory food often excites appetite and makes it possible for a light meal to be eaten to advantage. As a rule, however, one feels the desire for food when there is actual need of nourishment on the part of his cells.

But the importance of hunger depends upon the fact that it is more than a gland stimulus. Under normal conditions it is a reliable food indicator, showing when the body needs food and when it has the ability to digest. Hence to avoid eating without appetite is to avoid taking in more material than the body needs, and the introduction of food when it cannot be worked up to good advantage.

**Chewing and Tasting.** — Chewing serves as a mechanical and taste as a chemical stimulus to the glands of digestion. The more elaborate the chewing process and the greater the appreciation of taste, the greater the flow of the juices. Chewing separates the solid particles of food, giving more surface for action of the digestive fluids. By increasing in this way the dissolving action in the mouth, it greatly enhances the taste of various substances and makes this more effective as a gland stimulus. It is in recognition of the fact that taste is a means of gland excitation that highly seasoned foods are sometimes preferred to those containing only their natural flavors, though the use of pepper, mustard, vinegar, and an excess of salt are objectionable from other points of view. One who would use taste to advantage as a gland stimulus must cultivate an appreciation for the natural tastes and flavors of food as ordinarily served, and an aid to this is the making of hunger or appetite a condition for eating.

**Effects of Mental and Emotional States.** — It is a matter of everyday observation that food eaten during periods of mental strain or emotional excitement is likely to digest slowly and imperfectly. Unhappy states of mind close the glands, as it were, and prevent their stimulation through the means described above. The importance of avoiding these states and of cultivating their opposites is too frequently overlooked. The table is no place for settling difficulties or for administering rebuke. On the other hand, it is the duty of everyone to contribute to the general social atmosphere which renders the meal enjoyable and digestible.

**The Element of Time.** — The secretion of the digestive fluids, those of the stomach and small intestine as well as those of the mouth, is most rapid during the period of taking food. This is due to causes that are in part mechanical, in part chemical, and in part psychical. A short period for eating means a correspondingly short period for the pouring out of all the juices that contribute to the work of digestion. We must not delude ourselves with the belief that food bolted into the stomach will, by mechanical stimulation, secure the juices necessary for its digestion. The stomach does not work in this way. To a very large extent the digestive juices stop flowing when we stop eating. If we would be sure of an ample supply we must give time to this process.

**Effects of Food upon the Digestive Glands.** — The Russian physiologist, Pawlow, has shown that the kind of food used is a determining factor in the composition of the juices secreted, and that a change in diet will in time lead to a change in the juices themselves. "If one alters the diet of an animal and goes on giving the new food, he finds that the ferments (enzymes) contained in the digestive juices accommodate themselves more and more every day to the new diet. If, for example, one feeds a dog for some weeks on milk and bread only, and then changes to a purely meat diet, which contains much more protein and almost no starch, he observes a gradual increase in the protein ferments of the pancreatic juice. The capability of digesting protein increases from day to day, whilst conversely, the starch digesting-power falls off."[1]

The principle brought out in this investigation has a most important bearing upon the processes of digestion. It makes possible adjustments of diet, such as were pointed out in Chapter VII, to meet individual needs, and shows at the same time the advisability of depending regularly upon the same articles of food for the greater part of one's nourishment.

**Digestive Interference from Waste Accumulations.** — A coated tongue, bad taste, and foul breath are all indications of a disordered and polluted condition of the food canal. While this results from various causes, it is chiefly due to the retention in different parts of the canal of materials which should have been passed on. Objectionable in itself, this material presents a formidable interference with the processes of digestion. On mixing with the food it starts undesirable chemical reactions which destroy nutriment and produce harmful compounds.[2] Clean mucous surfaces are as essential to good digestion as are clean test tubes, beakers, flasks, etc., to successful experiments in chemistry. If one is to avoid digestive difficulties, he must understand the causes leading to waste collection throughout the canal and the simple methods of securing relief. The more common of such causes are the following:

1. The taking of food while the stomach still contains undigested material from the preceding meal. This may

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[1] From Hutchinson's *Food and Dietetics*.

[2] Perhaps the worst result from the accumulation of decaying material in the stomach and intestines is the production, through fermentation, of harmful substances, such as acids, gases, and ptomain compounds. The dangerous disorder, known as acute indigestion, has this for its primary cause.

occur from eating between meals or from overeating at the regular period. The material already in the stomach mixes with that entering, and in this way is retained until it decomposes or decays.

2. By the use of foods which digest with difficulty. Most indoor workers have their idiosyncrasies in foods, certain ones almost invariably giving trouble. The unwholesome condition may arise directly from these or from the effect which they have on other foods.

3. Constipation. If the bowels do not move freely and regularly, the natural outlet of the great body sewer is stopped and the body wastes are retained. Constipation stands first among the causes of waste accumulation in the food canal.

**Cleansing the Food Canal.** — The causes of waste accumulation in the canal suggest the more important of the methods of preventing and relieving it. Eating between meals, overeating, and the use of foods that give trouble in digestion should be avoided. The stomach must be given opportunity for resting and ridding itself of objectionable débris. On the other hand, one should make a free use of foods that have a cleansing effect upon the food canal, such as fruits, provided these do not lead to harm in other ways (page 134).

On account of their acids, fruits rich in juices, such as apples, oranges, peaches, and grapefruit, may be classed as alimentary cleansers. They tend to clean the tongue and no doubt have a similar effect upon the linings of the stomach. To profit by the cleansing effects of fruits, however, they should be taken when the stomach is practically empty and should be unmixed with other foods (page 136). A complete meal of juicy fruits and the avoidance of all other foods until the next period for eating, will generally dissipate the accumulated filth, provided the bowels are sufficiently active at the same time.

The taking of two meals a day instead of three is conducive to alimentary cleanness in that it gives time for complete emptying of the stomach, but this method may fail to supply the necessary food for energy for the different portions of the day. Hence when the occupation calls for a considerable outlay of energy, it is better to eat the three regular meals, but to limit each meal to actual needs.

By far the most important method of promoting alimentary cleanness, however, is that of keeping the bowels sufficiently active and regular, or preventing constipation. Both on account of its bearing upon digestion and upon the general problem of waste elimination, this topic requires special consideration.

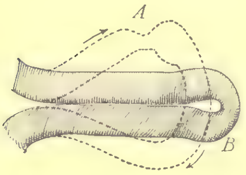

FIG. 36. — **A Peristaltic Wave** in a section of the small intestine. By the contraction of longitudinal muscle at *B* the tube is straightened, while the contraction of circular muscle at *A* forces material through the straightened portion.

**Method of Propulsion through the Canal.** — The movement of materials through the canal is accomplished by means of the contraction of the muscles within its walls. These exist, for the most part, in two layers — an inner layer in which the fibers encircle the tube, and an outer layer in which they run lengthwise. By a peculiar mode of contraction (Fig. 36), known as *peristalsis*,[1] these muscles act upon the alimentary contents to propel them along. The peristaltic contractions are in turn dependent upon the nerves connected with the layers of muscles, and these are stimulated both by materials within the

[1] See *The Human Mechanism*, page 122.

canal and by pressure from the abdominal walls. While the secretions from the various glands, by keeping the materials moist and lubricated, enable their passage to take place with little friction, *insufficient peristalsis is the great fundamental cause of constipation.*

**Indications of Constipation.** — The chief indication of constipation is failure on the part of the bowels to move one or more times a day. This indication, however, is not entirely reliable. Physicians report an occasional case in which the bowels act normally at longer intervals than a day, and constipation may prevail and there be, at the same time, a form of diarrhea in which the discharges are of a watery nature. (The diarrhea results in such cases from a catarrhal condition of the intestines excited by the hardened feces[1] or by attacks of bacteria.) In many instances the movements of the bowels occur regularly, but there exists a condition of partial constipation, *i. e.*, the residue of waste is only partly discharged. Generally speaking, the bowels may be considered as insufficiently active when there is strain in evacuation, when the feces are dry and lumpy, when the breath is bad and the tongue coated, and when there is a sallow or unhealthy color of the skin.

**Effects of Constipation.** — In addition to being a direct hindrance to digestion, constipation interferes with health in a number of other ways. The hardened feces remaining in the food canal irritate the mucous lining, and this irritation in some instances paves the way for appendicitis and kindred ailments. By irritation in the region of the rectum, they are the usual cause of piles, or hemorrhoids. Wastes decomposing in the large intestine from attacks of bacteria also give rise to harmful products which are absorbed into the blood. These injure the cells of the nervous system and induce hardening of the walls of the arteries. There is also more or less absorption of the wastes secreted by the liver and other glands when constipation prevails, and this greatly increases the work of elimination.

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[1] The term *feces* is applied to the mixture of wastes discharged from the food canal. These consist of undigested portions of food; of wastes secreted by the liver and other glands emptying into the canal; of products resulting from the decomposition of materials in the large intestine; and of bacteria, both dead and alive, passing from the large intestine. Normally the feces are soft, on account of the water which they contain, but in constipation much of the water is absorbed into the blood, rendering them hard and lumpy.

Headache, dizziness, feelings of depression, dullness, and chronic fatigue, and a lack of energy are among the common effects resulting from constipation. Not only is good health impossible so long as this condition prevails, but during its continuance there is also constant danger of disorders vastly more serious.

**Causes of Constipation.** — A great variety of causes may operate to induce constipation and these may act singly or in combination. With the causes of the temporary stoppage of the bowels, such as changes in diet or water, germ attacks, mechanical obstruction of the intestines, and the effect of certain drugs, we are not so much concerned as with the conditions more or less under control, that are responsible for chronic constipation. Of the various causes which, by *diminishing peristalsis*, induce chronic constipation, the following are the most important:

1. *A general run-down condition of the entire body.* — If from overwork, attacks of disease, or other causes, the body drifts into a state in which it habitually generates less energy than is needed for internal and external work, all the vital processes are carried on less effectively than

they would be under normal conditions. Disorders of the digestive system are among the first to appear and, among these, constipation. Proof that constipation results from general weakness, including nervous exhaustion, is easily found. On the days following undue exertion, constipation is usually more pronounced, and as a result of rest and relaxation it may entirely disappear. Students while under the strain of examinations quite frequently observe a tendency toward the stoppage of the bowels. People who are habitually constipated frequently experience relief during a period of vacation only to have the trouble return on getting back into the regular routine of work.

2. *Insufficient exercise.* — When insufficient exercise is taken, more especially when those forms of exercise are omitted that call the muscles of the trunk and abdomen into play, the coats of the intestines become thin and weak. Lacking in muscular tone they contract feebly, or not at all, when otherwise they would contract vigorously to propel the material along. Then if the muscles in the abdominal walls (Fig. 37) are relaxed and flabby, the intestines are situated, as it were, in a loose bag, from which they receive insufficient support and stimulation. Under

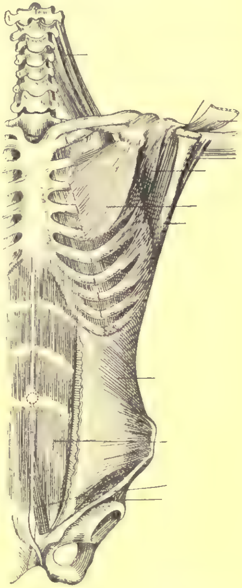

FIG. 37. — **Muscles which Support Abdominal Organs** (Morris). A weakened condition of these muscles is among the most frequent causes of constipation.

normal conditions the abdominal walls massage the intestines, thereby improving their blood supply and exciting peristalsis. This effect is lost when insufficient exercise is taken.

3. *Improper posture.* — Any position habitually assumed which induces a backward instead of a forward bend in the small of the back, and which relaxes the front abdominal wall (Figs. 38 and 39), is a pronounced cause of constipation. Such positions, like insufficient exercise, remove a natural stimulus to peristalsis. They also cause displacements of the abdominal organs which, in some instances, develop mechanical obstruction to the free movement of materials through the intestines.

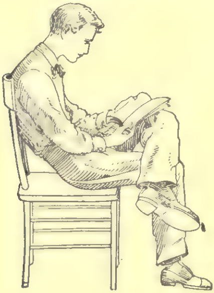

FIG. 38. — **A Frequently Assumed Position** which is a recognized cause of constipation.

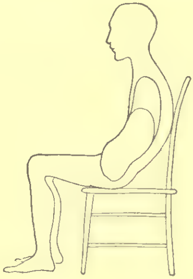

FIG. 39. — **Outline** showing the effect upon the breathing space, the front abdominal wall, and the spine, of the position shown in Fig. 38.

4. *Concentrated diet.* — A diet consisting of concentrated foods, such as eggs, rice, white bread, and pastries, which digest completely, leaving but a small residue of waste in the canal, is a frequent cause of constipation.

Since the intestinal muscles depend in part for stimulation upon materials within the canal, they cannot contract so vigorously from a small as from a large residue of waste.

5. *Improper clothing.* — Tight clothing around the waist tends to cause constipation by impeding the movement of materials through the transverse section of the large intestine, by preventing movements of the diaphragm, and by weakening the abdominal walls. The last two effects interfere with agencies that induce peristalsis. The greater prevalence of constipation among women than among men is accounted for by their lack of exercise and by their tight clothing.

6. *Insufficient water.* — In most cases of constipation the feces are dry and hard, showing a lack of water in the intestines. Not only is water an important aid in the movement of materials through the canal, but it prevents irritation of the mucous linings by the feces. Water also increases the intestinal bulk and this is an important factor in exciting peristalsis.

7. *Irregular habits.* — The entire body is known to work better when a definite sequence of activities is observed than when there is more or less irregularity. By observing regular periods for work, rest, sleep, and the taking of food, the conditions of health are more certainly established. For the same reason, the observance of a regular period each day for evacuating the bowels has a pronounced effect upon their activity. Many people trace their tendency to constipation to passing over, for convenience, the period when the natural desire should have been heeded.[1]

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[1] Of special importance is the heeding of the "call" to evacuation. If for convenience the desire to evacuate is suppressed, the nervous mechanism for accomplishing this purpose soon loses its sensitiveness and becomes less efficient in exciting peristalsis.

**The Attack upon Constipation.** — Relief from constipation is secured through the removal of the cause or causes which are responsible for its continuance. If a single cause, such as improper posture or insufficient exercise, is responsible, relief is easily secured. If there be a combination of causes, such as may be present in a general run-down condition of the body, the problem of relief becomes much more difficult. Many so-called cures for constipation have been proposed, but each of these usually has reference to but a single cause and can be successful only so far as the particular cause is responsible. Most of these remedies are worthy of consideration, however, from the fact that, together, they show the wide range of influences that may affect the passage of materials through the intestines.

**The Exercise Cure.** — Exercises that bring into play the muscles of the trunk, more especially those of the abdomen, such as rapid walking, hill climbing, rowing, wood chopping, and such games as volley ball (page 67), golf, and tennis, improve the muscular tone of the intestines and of the abdominal walls and greatly improve the circulation through these parts. Many people find in such exercises an effective means of relieving constipation so long as they are diligent in keeping them up. A number of special exercises for relieving constipation have also been devised, and these secure relief by calling into play the muscles of the abdomen. The exercises for strengthening the abdominal walls, described on page 66, are an aid in securing relief, though others somewhat more effective may be taken. A movement of special value in relieving constipation is the so-called

**"Figure Eight" Exercise.** — Standing with the feet twenty or more inches apart and the head and trunk slightly inclined, the hands are clasped and extended forward, and then by a long side to side, sweeping movement, they are made to describe the figure 8 (Fig. 40). The entire upper portion of the trunk is moved in conjunction with the hands, the weight alternately shifting from one foot to the other, and the work of bending, straightening, and twisting the trunk accomplished as nearly as possible by the muscles surrounding the abdomen. In practicing this exercise one should avoid strain and should never carry it to the extent of causing pain in any of the abdominal or pelvic organs.

**Diaphragmatic Breathing.** — In the use of the diaphragm in breathing, periodic pressure is exerted upon the stomach and liver which displaces these organs vertically and improves the circulation in the abdominal region. The liver especially is supposed to derive benefit from its excursions and from the massaging effects of the diaphragm upon it, and these effects, together with the effect of full breathing upon the chemical processes, makes diaphragmatic exercise a positive aid in preventing and overcoming constipation.

**The Exercise of Laughing.** — Laughing has long been recognized as an aid in digestion, the adage "laugh and be fat" being some hundreds of years old. Through the rapid up-and-down movements of the diaphragm in laughing, the liver is given a shaking which it gets in no other way. In addition to this, laughter relieves nervous tension which is a hindrance to the processes of digestion.

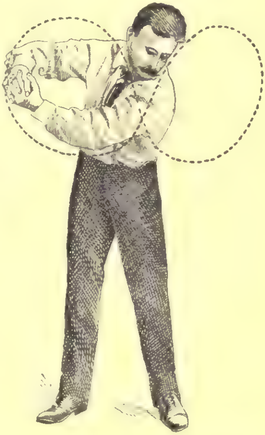

FIG. 40. — **The "Figure Eight" Exercise.** This exercise is especially valuable for developing the abdominal muscles (Fig. 37) and for stimulating peristalsis.

**Cure through Posture.** — The maintenance of correct posture should, for many reasons, be ranked first among the agencies for the relief of constipation. Importance should be attached to the fact that it is a continuously acting cause and that it serves other essential purposes. To apply the principle one needs only to put into practice what has already been learned (Chapter V) relative to proper positions in sitting, standing, and walking. While the head should be erect, the chin slightly depressed, the neck back, and the shoulders flat, the more essential points in relieving constipation are those of keeping the abdominal walls tense, or taut, by lifting the chest, and the maintenance of a moderate forward curve in the small of the back (Fig. 22).

**The Nerve Cure.** — Many cases of chronic constipation have been cured through suggestion (page 285) and the more general application of the principles of mental therapeutics. Worry, fear, and mental anxiety check peristalsis (page 282), and there may be so much nervous energy used or wasted through intellectual, emotional, and other activities, that there is not sufficient left for running the vital processes. That constipation induced through nervous causes should be cured through nervous means — checking harmful emotional states and so directing bodily activities that the digestive organs get their share of nervous energy — is both natural and logical. To secure the best results, however, one must give attention to all those conditions upon which the health of the nervous system depends (Chapters XII, XIII, and XIV).

Of special importance is the state of the nervous system as the period approaches for evacuation. If this is to follow breakfast, then the time from rising until evacuation occurs should be one of mental quiet. There should be no anxiety, worry, or serious study, but the nervous energy which would be spent in these ways should be used in breakfasting and in the encouragement of the reflexes necessary for evacuation. This quiet beginning is also the best preparation for a day of strenuous activity.

**The Water Cure.** — Relief from constipation is frequently found by simply increasing the amount of water. If the absorption of water by the blood does not leave a sufficient amount in the canal, the logical remedy is to drink more (page 124). A big drink on retiring at night and another on rising in the morning is of especial advantage in the avoidance of constipation.

To force oneself, however, to drink large quantities of water with the idea of curing constipation when other causes are responsible for the condition, can only end in disappointment.[1] The attempt is also inadvisable on account of possible harm in individual cases. As regards the excess of water which people are advised to drink at mineral springs, it may be said that substances in solution in these waters have much to do with the amounts which can be taken with impunity.

**Relief through Diet.** — A diet containing considerable coarse food is one of the most generally recommended remedies for constipation. Such foods as corn bread, apples and other fruits, cracked wheat, cabbage, celery, lettuce, and all kinds of vegetables, on account of the indigestible material (cellulose) which they contain, are a positive aid in exciting peristalsis.[2] Again, the kind

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[1] With reference to the widely advertised method of relieving the bowels through rectal injections of water, it may be stated that while this method can be occasionally used for securing temporary relief, it is very likely to result in harm if regularly employed.

[2] "As a further means of imparting sufficient bulk to the diet, agar-agar, or Japanese seaweed, called also Ceylon moss, is to be highly recommended. In all cases of sluggish bowel action, it may be used without any possible injury. When properly prepared it is wholly free from unpleasant flavors. Moreover, it is sufficiently hygroscopic to insure against dryness and hardness of the bowel contents. . . . Agar-agar is easily taken in soups, cereal coffee, fruit juices, or stewed fruits, being softened and then swallowed without chewing." — From Kellogg's *Constipation: How to Fight It.*

A bread which many have found a sufficient preventive for constipation is prepared according to the following recipe: Two cups of wheat bran, of food, independent of bulk, is a factor of importance. Certain foods, such as cheese and milk, are constipating for some, while other foods, such as onions, prunes, figs, raisins, and honey, act as mild laxatives.

**The Rest Cure.** — The rest cure is based upon the fact that a large number, perhaps the majority, of cases of constipation in adults result from general overwork or from strain upon the nervous system. Rest enables the body to catch up in the matter of energy production and gives opportunity for the nervous system to recover from the strain to which it has been subjected. The rest cure is best applied through complete withdrawal from vocational activities and a change of scene, but in many instances the desired results may be accomplished by simply making the daily routine less strenuous and avoiding unnecessary nervous expenditures. In the general upbuilding of the body which is necessary to relief in some cases, sufficient rest is an indispensable condition. Rest, however, must not mean the entire suspension of physical exercise.

**Relief through Massage.** — Expert masseurs and osteopathic physicians are able to relieve constipation by mechanical manipulation and stimulation of the intestines through the abdominal walls. By external pressure upon the large intestine, applied by a downward, forward, sweeping stroke, material may be passed from the cœcum to the rectum, the pressure being applied in the direction taken by the bowel contents (indicated by the dotted

one cup of flour, one small teaspoonful of baking soda sifted into the bran, a pinch of salt, two tablespoonfuls of New Orleans molasses, enough milk to make a batter, one egg, and one teaspoonful of melted butter. The bread may be cooked as biscuits or baked as a small loaf and then cut into slices. This is eaten as a part of the regular meal, one serving a day usually being sufficient.

line in Fig. 42). Since the small intestine is so tortuous in its course that it cannot be followed from the outside, a thorough kneading of the central abdomen must suffice for stimulating within it an adequate peristalsis. While this method is not usually recommended for self-application, it is highly suggestive of the value of the natural massaging that results from exercise and from the maintenance of correct posture.

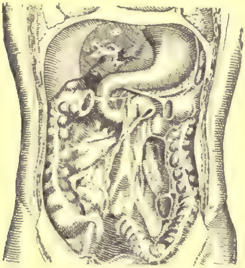

FIG. 41. — **The Large Intestine.** It is usually this portion of the canal which is clogged in constipation.

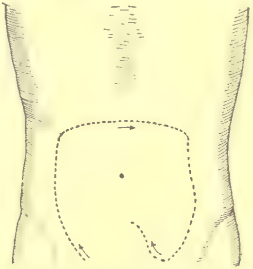

FIG. 42. — **Front View of the Abdomen,** showing the line followed by the masseur in stimulating the large intestine.

**The Use of Medicines in Constipation.** — Though some of the medical remedies tend to interfere with the normal working of the digestive system, their bad effects, when properly administered, are as nothing, compared with the results that arise through failure adequately to relieve the bowels. One should not, however, habitually rely upon drugs, but while taking them as occasion requires, continue his efforts for obtaining relief through hygienic means. Medicines for relieving constipation are roughly classed, according to their modes of action, into two groups:

1. Saline laxatives, such as Epsom salt, sodium phosphate, and certain mineral waters which, by reversing

the osmotic relation between the contents of the food canal and the blood and the lymph, cause temporarily a greater flow from the tissues into the food canal.

2. Substances which increase the fluids in the canal and stimulate peristalsis by their effects upon the nerves controlling the glands and the intestinal muscles. To this class belong rhubarb, senna, licorice, aloes, phenolphthalein, and calomel. Calomel, however, is of such a drastic nature that it should never be taken except under competent medical advice.

**General Method of Relief.** — Whether the indications point to a single cause of constipation or to a combination of causes, the one who is seeking relief must attend to those fundamental conditions upon which normal peristalsis depends. Correct posture must be maintained, sufficient exercise taken, and water used in sufficient quantities. The nervous energy must be conserved and overwork of all kinds avoided. A small amount of coarse food should be a part of every meal and there should be established the habit of a daily movement at the same hour. And finally, the general vigor of the body must be increased through attention to all the means for accomplishing this purpose.

Supplying the last-named condition often requires time, and during this time there should be daily evacuations. The building up of bodily vigor without this assistance is scarcely possible. Hence in cases where the condition does not yield quickly to hygienic treatment, recourse must be temporarily made to mild laxatives. In the selection of a laxative adapted to individual needs and in its administration in such a manner that it may finally be dispensed with, a physician experienced in the treatment of chronic constipation should be consulted.

**Summary.** — In supplying conditions for the improvement of the digestive organs, we are confronted by two main problems: First, to secure the digestive fluids in sufficient amounts and of the right quality. Second, to maintain a clean condition of the food canal. Bearing upon the first problem is the time given to the meals, the thoroughness of mastication, the appetite, the kind of food and its condition, and the state of mind and of the nervous system at the time of eating. Essential to the solution of the second problem is avoidance of overeating and eating between meals, and a sufficiently rapid movement of materials through the canal. Both on account of the far-reaching effects of constipation and the many causes contributing to its continuance, this condition must be attacked systematically and persistently. While the use of mild laxatives under medical advice is permissible for temporary relief, the individual should not cease in his efforts to establish and maintain normal peristalsis.

**Exercises.** — 1. Name the different kinds of work performed by the organs of digestion. What is their main function?

2. Give directions for the proper care of the mouth.

3. Upon what essential conditions does good digestion depend? Compare with an experiment in chemistry.

4. Why should appetite increase the flow of the digestive fluids? Of what importance is thorough mastication?

5. What are the advantages of eating slowly and of giving plenty of time to the meal? What conditions of the mind and of the nervous system are conducive to good digestion?

6. In what ways does an unclean condition of the food canal interfere with digestion?

7. How does overeating cause the tongue to become coated? How may eating between meals foul the breath?

8. Explain the general method by which materials are propelled through the canal. Define peristalsis. In what different ways are the nerves controlling peristalsis stimulated?

9. Enumerate the different causes of constipation. What is perhaps the most general cause?

10. How may nervous exhaustion cause constipation? How may insufficient exercise induce the same condition?

11. How does insufficient water increase the tendency to constipation? How much water does the body need and at what times is it best taken?

12. Why should a portion of the diet consist of coarse foods? How may too much coarse food be detrimental?

13. What forms of exercise are beneficial in relieving constipation? Why so?

14. State the general method of procedure in relieving chronic constipation.

15. Under what conditions may the use of laxatives be advisable? Why are the mild laxatives to be preferred?

## Health Work

Facts brought out in the present chapter suggest the importance of several habits whose effects from day to day may be slight, but whose cumulative results will profoundly influence the health.

**Habit VI.** *Of Mastication.* Eat slowly and masticate the food thoroughly.

**Habit VII.** *Of Supplying Appetite.* See that the conditions necessary for good appetite are daily supplied. If appetite be lacking at mealtime, eat lightly or not at all.

**Habit VIII.** *Of Cheerfulness.* Be agreeable and cheerful at all times, but more especially during and following meals.

**Habit IX.** *Of Elimination.* Have a definite period each day for evacuating the bowels and observe all necessary conditions for avoiding constipation.

In addition to these general habits, there are a number of special problems relating to the welfare of the digestive organs. Some of these can be solved by the individual, while others will require the aid of the physician.

**To Improve the Appetite.** — On account of the important part played by the appetite in the secretion of the digestive fluids, everyone should know the natural means of keeping it up. The appetite depends essentially upon a real demand for food. This demand is increased by increasing the bodily activity, especially in the matter of physical exercise. The greater consumption of material at the cells requires that more be introduced, and this increased need is expressed through the appetite. A second means of improving the appetite is to limit the amount of food taken, and this may be done either by eating less at each meal or by reducing the number of meals. The greatest enemies of the appetite are overeating and insufficient exercise.

**To Relieve Irritation of the Stomach and Intestines.** — Burning sensations and dull pains in the abdominal region usually result from irritations inside the food canal, and these may be either mechanical or chemical in their nature. Since these irritations may lead to serious conditions, such as ulcerations and attacks of appendicitis, the means for their relief must be diligently sought. The mechanical irritations usually depend upon hard particles in the food, upon accumulating gases in the stomach and intestines, upon constipation, and upon insufficient water in the food canal. The chemical irritations are caused by acids and other harmful agents resulting from indigestion and fermentation. These causes suggest the following remedies:

1. Thoroughly masticate the food, giving special attention to hard and tough substances, such as popcorn, nuts of all kinds, and cheese.
2. Use sparingly, or avoid altogether, acid substances, such as acid fruits and pickles, and fermentable substances, such as sugar, until relief is secured.
3. Avoid constipation.
4. If there is a tendency toward biliousness, avoid much of fatty substances until this condition is relieved.
5. Drink plenty of water.

Colicky pains are usually caused by accumulations of gas, the result of fermentation, and are prevented by avoiding fermentable substances. It is well also to remember that prolonged chilling may cause intestinal irritation, producing colic and sometimes diarrhea, from the congestion of the mucous linings.

**To Relieve Simple Cases of Indigestion.** — Indigestion may arise from overeating and eating between meals, from eating too much sugar, and sometimes from eating too much fruit. In some instances the trouble will depend upon substances which are difficult to digest and in others upon an overwrought condition of the nervous system. A contributing factor in nearly all cases is some degree of constipation. Indigestion is relieved by the removal of the cause or causes that are responsible for its presence.

The very serious condition, known as acute indigestion, requires the prompt assistance of the physician. In what appears to be serious trouble, if the physician cannot be secured at once, it is well to take an emetic or in some other way induce vomiting.

**To Induce Vomiting.** — Perhaps the simplest method of inducing vomiting is that of thrusting a finger far down the throat. To make the method effective, the finger should be held in the throat until the vomiting begins and put back again when the process ceases, repeating until no more material can be brought up. The emetic usually recommended for home use is a glass of lukewarm water containing a teaspoonful of finely ground mustard.

**To Relieve the Coated Tongue, the Bad Taste, and the Fetid Breath.** — These conditions are usually due to indigestion and disappear as digestion improves. Perhaps no one condition is more directly concerned in the production of all of them than a general inactivity of the bowels, and the first effort should be to secure relief from constipation. The fetid breath is in most cases due to the imperfect digestion of fats and the accumulation of fatty acids having a bad odor. Because of the ability of calcium hydroxide to combine with fatty acids to form calcium soaps, lime-water (a solution of calcium hydroxide in water) is perhaps the best substance for counteracting an offensive breath. Two or three tablespoonfuls of lime-water in a half tumbler of water taken between meals usually suffice. (Lime-water may be purchased at a drug store or prepared by stirring a little freshly slaked lime in a jar of water and giving the undissolved solid time to settle. The clear liquid is then used as desired.)

**To Relieve and Prevent "Sour Stomach."** — The sourness results from the introduction of acid substances and from the formation of acid through fermentation and is quickly relieved by drinking some mild alkaline solution, such as cooking soda in water (page 144). To prevent a recurrence the digestion should be improved and the particular substances that may have caused it should be avoided. These will be found in many instances to be sour fruits that have been sweetened to render them more palatable.

**To Relieve Constipation.** — While a number of remedies are suggested in the text, the student should have some idea of their relative importance from the standpoint of securing permanent relief. Everything considered, correct posture should head the list of remedies. Next to posture, and a necessary accompaniment of it, is sufficient exercise of the abdominal muscles, and following this, the conservation of the nervous energy as explained in Chapters XII, XIII, and XIV. Of the minor conditions to be observed, *a definite period each day* for evacuating the bowels comes first, and following this, in the order named, are the use of considerable coarse food, the drinking of sufficient water, and the wearing of clothing which is loose fitting about the waist. In securing natural relief it is usually necessary to give attention to all these conditions.

**To Preserve the Teeth.** — The teeth must be kept clean. Good authorities advise brushing them four times a day — on rising and after each meal. Lingering particles of food should be removed with a slender wooden toothpick or with dental floss, and without injury to the gums. Tooth pastes containing gritty substances should be used only occasionally. Rinsing the mouth once a day with some alkaline solution, such as cooking soda in water, is advisable in cases where the teeth have a tendency to decay. Decayed places should be filled just as soon as discovered, and a visit to the dentist should be made at least once a year for a general examination of the teeth. The dentist should also be consulted for abscesses and ulcerations at the roots of the teeth, for the cause of neuralgic pains of the head and face, and for the different kinds of mouth sores. Even a general nervous condition is sometimes associated with the teeth, and is relieved through the work of the dentist.

**To Increase the Weight.** — The chief causes of underweight are overwork, poor digestion, nervous strain, and ill health generally. An increase in weight is nearly always one of the results attained through health improvements. One in a fair state of health and not overworking, but under normal weight for his height, is most frequently so on account of digestive weaknesses, and for this reason will .make his most rapid gains through attention to conditions that improve digestion as discussed in the text. One item of considerable importance is the drinking of sufficient water.

**To Avoid Hemorrhoids, or Piles.** — These abnormal formations, which are described as "vascular tumors of the rectal mucous surface," have for their chief cause, constipation. If constipation be avoided, they usually do not occur, and in many instances they disappear without local treatment or surgical operation when this condition is relieved.

# CHAPTER X

## CONTROL THROUGH ELIMINATION

"Whatever enters the body as gas, liquid, or solid must leave it again as waste."

THE fourth and last problem in securing normal metabbolism is considered in the present chapter. Only as the materials which have served their purposes are removed can new materials be introduced into the body. Many of the wastes, moreover, are of a poisonous nature, and as they increase beyond a certain concentration, they interfere with chemical processes and injure the cells. To throw off wastes as fast as one takes on cell nourishment is essential to good health and efficiency.

**Upon what Effective Elimination Depends.** — The effective elimination of waste depends upon the observance of several conditions, some of which have already been considered. It depends upon a degree of chemical activity sufficient to reduce harmful wastes to those that are harmless in small amount and to change wastes difficult to remove into compounds that are easily passed from the body. It depends upon the body's receiving such kinds and amounts of foods as can be used to good advantage and upon the efficient action of the organs of digestion, especially the large intestine. And it further depends upon the healthful operation of the recognized organs of elimination - the kidneys, the liver, the lungs, and the skin. Agencies which affect the efficiency of these organs are considered in the present chapter.

**Work of the Kidneys.** — The kidneys, unlike the other organs of elimination, are devoted almost exclusively to the removal of waste.[1] This is passed from the body by a liquid which they secrete, called the urine. The urine is composed of water and a variety of solid wastes, such as urea, uric acid, sodium chloride and other mineral salts, and coloring matter, these being held in solution by the water. The constituents of the urine vary, however, with different conditions of the body and with the materials taken as food. There is also considerable variation, under normal conditions, in the quantity secreted. Usually the more water one takes, the greater the quantity of urine, but if one sweats freely the urine may be less in amount.

**Urea and Uric Acid.** — Urea ($CON_2H_4$) is a white, crystalline solid, easily soluble in water. It is the most abundant of the wastes eliminated by the kidneys and is the chief compound formed by the breaking down of the proteins, including those forming the cell protoplasm. Both the liver and the kidneys are concerned in the removal of urea. The products of protein oxidation at the cells are picked up by the blood and transferred to the liver. This organ converts them into urea and other wastes, passing the urea back into the blood. This is now removed by the kidneys, with the exception of a small amount eliminated by the skin. What the skin removes, however, is considerably increased when the secreting cells of the kidneys are diseased. The average individual eliminates about 32 grams of urea per day.

Uric acid ($C_5H_4N_4O_3$) is a crystalline solid, nearly insoluble in pure water, but soluble in alkaline solutions, such as solutions of caustic soda or potash in water. The amount which appears in the urine is quite small, and this varies with the kind of food and the state of the health (page 131).

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[1] According to some authorities, the kidneys secrete an assistive agent which, on entering the blood, aids in the internal work of the body.

**Uremic Poisoning.** — Physicians recognize a serious disorder, known as uremia, or uremic poisoning, which arises from the retention of kidney wastes in the body. It is marked by nausea, headache, dizziness, dimness of vision, coma or convulsions, and by a urine-like odor of the perspiration and breath. Death is a frequent result of acute attacks. Because of the serious nature of uremic poisoning, a physician should be consulted whenever there is considerable suppression of the normal flow of the urine or when there is other evidence that kidney wastes are being retained.

**Kidney Liabilities.** — The kidneys remove from the body the normal wastes found in the urine, but are overworked and injured by unnatural wastes, such as result from imperfect chemical action and from the introduction of undesirable substances into the body. According to recent investigations, they may be seriously injured through an excess of acids.[1] Wastes resulting from nervous exhaustion also irritate them, causing an increase in their secretions. Alcohol acts as a decided irritant to the kidneys and is recognized as a chief cause in the production of Bright's disease.[2] Exposure to wet and cold, resulting in prolonged chilling of the skin, especially when one is recovering from some wasting sickness, causes inflammation of the delicate linings of the kidneys, often laying the foundation for serious trouble.

**Misunderstood Symptoms.** — In the popular mind, pain in the small of the back, an increase in the quantity of urine, and deposits of solids in the urine on standing, indicate kidney disease. Although these symptoms have little or no relation to the condition of the kidneys, unscrupulous venders of patent medicines often take advantage of the belief to exploit their so-called kidney remedies. The pain in the small of the back is below the place where the kidneys are located and hence is not kidney pain.[1] The increase in the secretion of the urine may be from a variety of causes, and it is perfectly natural for urine to deposit solids on standing. Whenever kidney disease is suspected the urine should be examined chemically and microscopically by an expert in this work. This is the only method of determining whether the kidneys or the body in general are in need of treatment.

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[1] Martin H. Fisher, *Nephritis*.

[2] The effect of alcohol in injuring the kidneys and in the production of disease generally, is considerably enhanced by the presence of detrimental substances in the alcoholic beverages, such as acids in the various wines and purin bodies in beer and ale.

**Nervous Irritations and the Kidneys.** — The symptoms referred to above are usually accounted for by an exhausted condition of the nervous system. Nervous irritations of all kinds cause an extra amount of waste to pass into the blood. To throw this off the kidneys become more active, the quantity of urine being perceptibly increased. Hence one may expect unusual excitement, eyestrain, overstudy, worry, severe pain in any part of the body, or any other condition which overtaxes the nervous system, to increase the flow of the urine — this result being due to their effect upon the nervous system. Urine charged with such waste is also quite likely to irritate the bladder and to deposit more than the usual amount of solids. Furthermore, during a run-down condition of the nervous system one is liable to suffer from rheumatic and neuralgic pains and these, from slight muscular strain, are frequently felt in the nerves and muscles of the lower back region. Rest of the nervous system with relief from any kind of strain to which one may be subjected is the surest way of relieving the supposed kidney symptoms.

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[1] Disease of the kidneys is seldom if ever attended by pain. Some authors say there is no pain.

**Kidney Hygiene.** — The health of the kidneys is indirectly promoted and their work facilitated by the following methods:

1. By keeping up the general health and vigor of the body.
2. By observing conditions, when bodily vigor is low, which prevent accumulation of acids (page 143).
3. By avoiding excess in the use of tea, coffee, and meat, and omitting all kinds of alcoholic beverages.
4. By keeping the skin clean and active.
5. By avoiding constipation.
6. By avoiding eyestrain and other conditions that lead to nervous exhaustion.
7. By avoiding exposure to cold and wet, especially when the body is in an exhausted state or is recovering from some weakening disease.

**Work of the Liver.** — The liver may be compared to a chemical factory which elaborates substances of various kinds and carries on processes for the general good. One of its chief functions is to regulate the consumption of the carbohydrates. Standing as a guard between the organs of digestion and the organs of circulation, it removes any excess of sugar absorbed from the food canal, and by converting this into a solid substance, called *glycogen*, stores it away until needed by the cells. Then, by a reverse chemical process, it changes the glycogen back into sugar. This, upon dissolving, passes out into the blood where it is available for the cells.

Another function of the liver is to change harmful wastes into those that are harmless, an illustration of which is the changing of uric acid into urea (page 131). It also separates the broken-down constituents of the red corpuscles from the blood, adding them to its secretion, known as the *bile*. Though composed essentially of waste, the bile renders important service in the small intestine, aiding in the digestion of fat and serving as a natural antiseptic and as a laxative. If from any cause the flow of the bile is interrupted, two serious conditions arise:

1. The bile wastes remain in the body where they act as poisons and discolor the skin. The condition known as jaundice results from this cause.

2. The processes of digestion are interfered with, constipation resulting and intestinal bacteria becoming more active.

**Liver Interferences.** — The work of the liver may be interfered with in a number of ways. Insufficient oxygen in the blood interferes with its chemical processes. Lack of exercise slows its circulation and removes a natural aid in the discharge of the bile. Tight clothing around the waist tends to compress and displace the liver and to close the duct into the small intestine. Prolonged chilling, and also the entrance of bacteria from the small intestine, may induce a catarrhal condition of the gall bladder and its connecting tubes which in turn impedes the flow of the bile. But most serious of all is the occasional clogging of the liver outlet by concretions, known as gall-stones.[1] While a lack of liver secretion is a direct cause of constipation, constipation from other causes reacts harmfully upon the liver.

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[1] The usual causes of gall-stones are a lack of physical exercise, tight clothing around the waist, and the presence of bacteria in the gall-bladder and its connecting tubes. The high percentage of cases among people who have had typhoid fever is explained by the passage of typhoid germs from the intestine into the gall-bladder. The fact that gall-stone cases are more numerous among women than among men (about three to one according to Dr. Wm. Osler) is explained by their inactivity and mode of dress.

**Liver Hygiene.** — Through exercise, deep breathing, outdoor life, etc., good bodily vigor must be kept up. This is imperative. Constipation must be avoided; by hygienic means if possible, by mild laxatives if necessary. Exercise of a jolting nature, such as running and horseback riding, should be freely indulged in, as well as the liver-shaking exercise obtained through a hearty laugh. Excess of lean meat, fatty substances, and sugar should be avoided, but fruits, green foods, and laxative foods in general (page 179), help to keep the liver active. Oranges and grapefruit seem to stimulate the liver in some cases, but those troubled with acid accumulation may be injured through their use. Fats should not be eaten while the liver is inactive; they will not digest. Pains from the region of the liver may forbode serious trouble, and when these are severe a physician should be consulted.[1]

**Work of the Lungs.** — The lungs and their related organs provide conditions for the exchange of gaseous materials between the body and the atmosphere. They admit oxygen into the blood and they expel carbon dioxide. There is some question as to whether the carbon dioxide is the only waste eliminated by the lungs, since breathed air has odor, especially if kept in a closed vessel for some time. Some authorities believe that this so-called "animal matter" is waste from the blood, while others account for it by substances (decayed and otherwise) evaporating from the membranes of the nostrils, throat, etc., over which the air passes. A small amount of water vapor is passed from the body by the lungs and may be condensed by blowing the breath against a cold surface.

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[1] Liver pains may occur in the lower right side of the chest and along the front margin of the ribs on the right side. They may also occur in the back, chiefly on the right side just below the shoulder blade.

**Carbon Dioxide and its Passage through the Blood.** — Carbon dioxide ($CO_2$) is a gaseous waste, formed by the union of oxygen with the carbon of the food and the cell protoplasm. Most of the free oxygen which enters the blood at the lungs (page 100), also passes out at the lungs, but as a part of the carbon dioxide. Formed at the cells, the carbon dioxide passes from them through the lymph into the blood, by which it is carried to the lungs. Its passage through the blood, as already stated (page 105), depends upon its solubility in water and upon its ability to enter into combination with the constituents of the plasma and, to a slight extent, with the red corpuscles. Special importance is attached to the presence in the blood of a small percentage of sodium carbonate ($Na_2CO_3$). This unites with the carbon dioxide at the cells, to form sodium bicarbonate ($HNaCO_3$), which reverts back to sodium carbonate at the lungs, letting the carbon dioxide pass into the air.[1]

**How the Removal of Carbon Dioxide is Interfered with.** — The excretory work of the lungs is interfered with by all conditions, such as incorrect posture, tight clothing, and lack of exercise, that lead to the habit of shallow breathing. The complete exchange of gases depends upon the penetration of air to all the minute spaces of the lungs. Lung elimination is further interfered with, in the case of the indoor dweller, by insufficient ventilation of the rooms

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[1] The union of carbon dioxide with the sodium carbonate and its separation from sodium bicarbonate are shown by the equations

$$Na_2CO_3 + H_2O + CO_2 = 2HNaCO_3 \text{ and}$$
$$2HNaCO_3 = Na_2CO_3 + H_2O + CO_2.$$

The decomposition of the sodium bicarbonate at the lungs leaves the sodium carbonate in the blood to unite with more carbon dioxide.

in which he lives and works. Not only this, but where ventilation is poor (page 109), diseases of the air passages are likely to get a start and these, of course, offer serious interference with the work of breathing. It must also be remembered that breathing is but the external phase of the process by which gases are passed between the cells and the outside atmosphere, and that abnormal physical and chemical conditions of the blood-stream may also interfere with the "internal breathing" of the cells (Fig. 25).

**Shortness of Breath: What it Means.** — Difficult or labored breathing, more frequently manifested when some unusual exertion is called for, may be due to either or both of two causes — insufficient lung capacity or some condition relating to the blood. If one has a low breathing capacity, the lung surfaces are insufficient for the exchange of gases between the blood and the air and the shortness of breath results from this cause. More frequently, however, the difficulty is in the blood, or in some weakness of the heart which keeps the blood from being circulated as rapidly as it should.

According to some authorities, shortness of breath is sometimes accounted for by a general condition of acidity (page 134), a result of which is to neutralize more or less the sodium carbonate of the blood. Dearth of sodium carbonate blocks the passage of carbon dioxide and this, remaining in the cells, keeps back the oxygen. Extreme cases of this kind occur in the so-called acid intoxication of the blood.[1] In such cases the accumulating acid interferes with the passage of the carbon dioxide to such an extent that breathing becomes extremely difficult, even when physical exercise is not being taken.

[1] If a rabbit is fed some acid which it cannot oxidize, such as hydrochloric, it soon becomes very short of breath, and if the acid is gradually increased, shows decided signs of asphyxiation. Examination of the blood shows that it contains much oxygen, but very little carbon dioxide, while further examination shows that the alkaline constituents of the blood are very largely neutralized. The asphyxiation is due, therefore, to the failure

**Lung Hygiene.** — Hygienic conditions having special reference to the elimination of carbon dioxide are the following:

1. Sufficient physical exercise.

2. Conditions that favor full breathing, such as erect posture, loose-fitting clothing around the chest and waist, and conscious deep breathing.

3. The spending of much time out of doors and thorough ventilation of living and sleeping rooms.

4. Conditions, such as exercise, outdoor life, and proper diet, which keep the blood in a proper condition for carrying oxygen to and carbon dioxide from the cells (page 105).

5. Conditions that increase the general and local resistance to diseases of the lungs and air passages (page 332).

**Work of the Skin.** — The eliminative work of the skin is accomplished through the sweat glands,[1] there being something like two million of these tiny structures in the body covering. Their secretion, called the perspiration or sweat, consists chiefly of water, but contains a small percentage of organic impurities, chiefly urea, and of mineral salts, of which sodium chloride is the most abundant. The amount of wastes removed by the skin, though small, varies with its activity, and this in turn with the individual and the conditions to which he is subjected.[2] The eliminative work of the skin is more readily controlled than that of any other of the organs removing waste.

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of the carbon dioxide to pass from the cells and let the oxygen enter.— Wells, *Chemical Pathology*.

[1] The oil secreted by sebaceous glands in the skin is not a waste, but a necessary substance for keeping the skin and its appendages soft and pliable.

[2] Authorities quite generally agree that the perspiration is not secreted primarily for the removal of waste, but as a fluid for cooling the body through evaporation. The solid matter which it contains varies under different conditions from .44 to 2.26 per cent (Hammersten).

**Upon what the Activity of the Skin Depends.** — The efficient elimination of waste by the skin depends mainly upon two conditions:

1. Upon the quantity of blood circulating through the dermis, or under layer of skin.

2. Upon an unobstructed condition of the pores, or outlets of the sweat glands.

In the effort to improve skin elimination, attention must be given to both of these conditions.

**To Increase Skin Circulation.** — In the accomplishment of this purpose, advantage is taken of the fact that the skin circulation is used to regulate the temperature of the body. If there be an excess of heat in the body, the blood is made to circulate more freely through the skin in order to throw it off. But if there be difficulty in keeping warm, the skin circulation is diminished in order to lessen the escape of heat. As shown in Fig. 43, the body has two sets of surface capillaries — a set in the skin and a set in the mucous linings of the various tubes and cavities. Having muscular and nervous control of the circulation, it will shift a strong flow of blood from one set of capillaries to the other as occasion requires. If one is chilled, the shift is from the skin capillaries to those in the mucous linings, so great sometimes as to cause congestions, but if the body is overwarm, there is an increased flow toward the skin. By supplying conditions that prevent the inward and favor the outward shift, a sufficient activity of the skin can be maintained.

**How the Principle is Applied.** — In applying the principle of temperature regulation to the end that good skin circulation be secured, two lines of work are necessary, these being to some extent antagonistic in their effects. On the one hand, the body must be put through a process of invigoration, the effect of which is to increase the chemical activities of the cells so that they produce more heat than is actually needed. This requires exercise, outdoor life, and a limited amount of exposure to cold — chilling of the body surface (page 98). On the other hand, the body must have sufficient protection from cold, especially when not exercising, in order to prevent the too rapid escape of heat. Precautions are necessary in carrying out both lines of work; either if overdone becomes unhygienic.

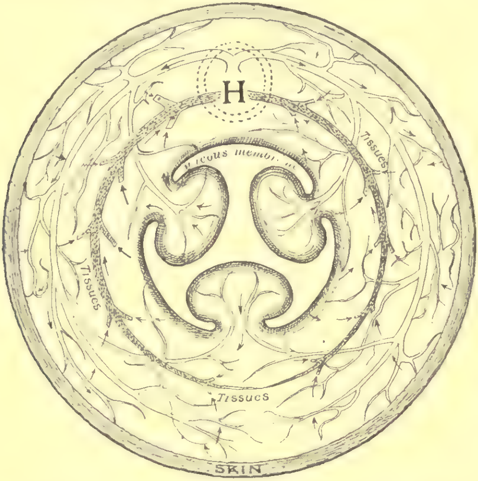

FIG. 43. — **Diagram of Arrangement for the Reciprocal Distribution of Blood to the Skin and the Mucous Linings.** Blood leaving the heart (H) passes to the skin, tissues, and the mucous linings, and is returned to the heart from these places by the veins. If the amount flowing to the skin is diminished, that flowing to the mucous linings is increased and *vice versa.*

**Avoid Extremes.** — Prolonged chilling drives the blood from the skin and exhausts the heat-producing powers of the body. It decreases the elimination of waste, causes congestions of mucous surfaces, and favors the depositing of wastes at the congested places. Colds, rheumatic pains, grip, and pneumonia frequently result from such chilling. Of special importance, on this account, is the protection of the body during sleep — the time when it develops least heat. A cold bed means imperfect elimination of waste by the skin, as well as interference with bodily rest and comfort.[1] Overprotection from cold, on the other hand, means diminished vigor and diminished capacity for the production of heat. These effects reduce the power of the skin, and of the entire body, to eliminate.

The problem is to expose the body sufficiently to develop its heat-producing and heat-regulating powers and to employ protection to the extent that these be not exhausted. Failure to secure a proper balance in this respect accounts for the harmful effects which sometimes follow laudable attempts to improve the bodily condition.

**Adapting the Cold Bath to Individual Needs.** — The cold bath affords such a valuable exercise, both for increasing the capacity to generate heat and for invigorating the body generally, that the indoor worker can scarcely afford to deprive himself of its benefits. The liability to overexposure, however, is so great in the usual method of cold bathing, that the results are more frequently harmful than otherwise. The fact is that anyone can take cold baths and be benefited by them, if he is careful to adapt the degree of exposure to the capacity of his body for reacting to cold. Anyone can wash his face, neck, hands, and chest in cold water without bad effects, and if this is the limit of his capacity, he may stop here at first. In the summer a quick sponge bath followed by a brisk rub with a coarse towel is scarcely too taxing for the weakest constitution, and it will pave the way to a vigor which will react to greater exposure — that supplied by the properly tempered shower bath and even the plunge bath.[1] The hygienic purpose is served when we get *the reaction which invigorates and avoid the overexposure which harms.*

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[1] Too much care cannot be given to arrangements for sleeping, especially in winter. While there must be good ventilation during the night, it is equally important that one should sleep warm. Attention must be given not only to the bed coverings, but also to the mattress and the springs. A mattress which is too compact readily conducts away bodily heat, and one which is uneven interferes with comfort. Frequent airing and sunning of all bedding is a hygienic necessity.

**How the Pores become Clogged.** — While the outlets from the sweat glands may become clogged from the collection of foreign material upon the body surface, the chief cause of obstruction is the solids left by the perspiration on evaporation. It is an interesting fact, moreover, that a diminished secretion of perspiration is more apt to close the pores than is free sweating. If the perspiration evaporates from the mouths of the pores (the method in so-called insensible perspiring) the solid wastes form plugs in the tiny tubes which may completely close them, whereas free sweating (sensible perspiring) carries the solids out on the surface, where they do much less harm (Fig. 44).

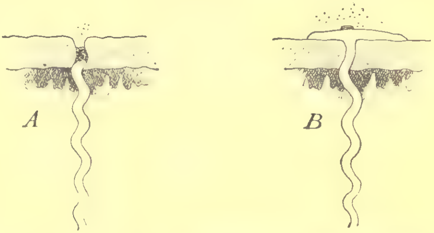

Fig. 44. — **A Closed and a Freshly Opened Pore of the Skin.** Insufficient exercise may cause the condition shown in *A*, while free sweating from exercise will produce the result shown in *B*.

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[1] The cold air-bath, which consists in the exposure of the body to cold air while the dry surface is briskly rubbed with the hands or a coarse towel, secures a mild reaction similar to that obtained with cold water, and is adapted to those lacking in bodily vigor.

The approved methods of cleansing the pores are warm bathing and through sweating from exercise.

**Effects from the Warm Bath.** — A bath may be said to be warm when the temperature of the water ranges from 92° to 100° F. From the standpoint of elimination such a bath accomplishes a double purpose. In the first place, it is thoroughly cleansing — removing both the surface impurities and the solid matter within the mouths of the pores — and, in the second place, it greatly increases, for the time being, the skin circulation. When properly taken it improves the complexion along with the eliminative work of the skin. On leaving the warm bath, one should dash or rub cold water over the surface. This contracts the skin muscles and stops sweating, thereby adapting the skin to the cold air. The body should then be quickly dried and given a brisk rubbing with a coarse towel.

If one lacks flesh, or if the skin is dry and thin, especially if there be a tendency to take cold after bathing, the use of a little olive oil is highly beneficial. Just enough is used to cover the body and this, by a process of rubbing and kneading, is thoroughly worked in with the fingers. The oil keeps the skin soft, and by protecting it from cold, helps retain in the skin the flow of blood that has been brought to the surface by the heat.

**The Hot Bath.** — A bath may be considered hot when the temperature of the water is above 100° F. Such a bath excites an abnormal flow of the perspiration and is usually taken for this purpose. While it has no advantage over the warm bath for one in ordinary good health, it can be used for remedial effects in disorders resulting from impaired metabolism. It is most frequently employed in the treatment of kidney disorders, rheumatism, and certain affections of the skin. The Turkish bath, the Russian bath, and the cabinet bath are varieties of the hot bath in which hot air or vapor are used instead of water to sweat the body. Since the hot bath comes within the range of medical treatment, it is usually omitted except when prescribed by the physician.

**How Exercise Cleanses the Pores.** — Vigorous exercise generates an excess of heat in the body, and this necessitates a better skin circulation and an increased flow of perspiration to keep down the body temperature. The perspiration forces its way through the tiny outlets (pores) from the sweat glands and carries out any solid material (Fig. 44) deposited by the insensible perspiring which prevails when no exercise is being taken. Because this material is left upon the skin, it is well to follow vigorous exercise with a properly tempered bath. Though profuse perspiration can be induced by other means, the natural and health-giving method is that of exercise.

**Effects of Massage.** — The rubbing and kneading of the skin with the fingers has the effect of increasing its circulation and is a means of enhancing its eliminative work. Massage is conveniently applied at the termination of the bath, on retiring at night, and again on rising. In addition to its general effects, it may be applied for the local invigoration of the skin. Applied to the scalp, massage tends to prevent baldness and to give a more healthful appearance to the hair. By massaging the face, the complexion is improved and facial blemishes, such as wrinkles, pimples, and blackheads, are to a considerable extent avoided.

**Cotton or Woolen Underwear: Which?** — The underwear should be non-irritating to the skin, retain the heat of the body, and readily take up the perspiration and pass it to the outer layer of clothing. Though the ordinary weaves of cotton are not so warm as those of wool, they take up and give off the perspiration more rapidly and are non-irritating. Since the fleece-lined and finely meshed cotton goods are conceded to be as warm as wool, weight for weight, we are brought to the conclusion that underwear made from these materials is to be preferred by those in good health for both winter and summer use. It may be added also that cotton is less expensive than wool and that the wearers of cotton have apparently a greater immunity from colds. On the other hand, people liable to be injured from the too rapid cooling of the body surface (old people, those having kidney disease or rheumatism, and those deficient in bodily vigor), find the woolen underwear better adapted to their special needs.

**Summary.** — To throw off as fast as one takes on is essential to continued good health and efficiency. To accomplish this purpose, the chemical activity of the body must be kept up, and foods and the processes of digestion so regulated that what is introduced does not exceed the capacity of the body to eliminate. Finally, conditions must be observed which favor the efficient action of the organs of elimination. The work of the kidneys, the liver, and the lungs is strongly influenced by conditions in the regular routine of living, while the eliminative work of the skin is vastly increased through individual effort.

Many conditions associated with indoor life interfere with effective elimination. Lack of exercise, shallow breathing, impaired chemical processes, nervous exhaustion and digestive difficulties, all conspire to lessen elimination and to clog the body with wastes. To every extent possible the indoor worker should indulge in physical activity and life out of doors, endeavoring to maintain the same degree of vigor that he would possess if his occupation kept him in the open. In so far as he fails to supply this essential condition must he give attention to special adjustments whereby effective elimination may still be accomplished, though on a lower plane of bodily activity.

**Exercises.** — 1. How do materials leaving the body compare in amount with those entering? How in chemical composition? How does their incomplete removal cause disease?

2. Enumerate all the conditions having to do with the effective elimination of waste. How does overeating render the process more difficult?

3. What wastes are removed by the kidneys? How does the eating of meat tend to overwork the kidneys? How does a purin-free diet lessen their work?

4. Name the so-called kidney symptoms which are frequently misinterpreted. What reasonable explanation accounts for all of them? What is their simple remedy?

5. Why does increasing the activity of the skin diminish the work of the kidneys? How may constipation increase it?

6. What different kinds of work are carried on by the liver? How does the liver regulate the consumption of the carbohydrates? What two kinds of eliminative work are performed by the liver?

7. How do horseback riding and laughing benefit the liver? How does a lack of exercise interfere with its work? Name conditions conducive to the formation of gall-stones? In what ways do these do harm?

8. What double service is performed by the lungs? How does physical exercise aid in their work?

9. Name conditions that influence the elimination of carbon dioxide. How does the imperfect elimination of carbon dioxide interfere with the taking in of oxygen?

10. State the causes for shortness of breath.

11. Upon what conditions does good eliminative action of the skin depend? How are these conditions secured?

12. What are the good and what are the bad effects of cold upon the body? How are the good effects secured and the bad effects avoided?

13. How may the cold bath be used to advantage by one run down in health? What special precautions must be observed?

14. Show how the pores of the skin become clogged.

15. State the advantages of the warm bath in increasing skin elimination. Of physical exercise for the same purpose.

16. Compare the relative merits of cotton and woolen underwear.

17. In what respects is outdoor life more favorable to the work of elimination than indoor life? How are the bad effects of indoor life to be avoided?

### Health Work

So intimately related are all the parts and processes of the body that the habits recommended in the preceding chapters, as well as habits recommended in the pages that follow, have a bearing upon the work of elimination. The facts brought out in the present chapter warrant the addition of two more habits to our list:

**Habit X.** *Of Skin Elimination.* Through exercise and through a system of bathing adapted to the bodily condition, keep the skin active.

**Habit XI.** *Of Bodily Comfort.* During periods of inactivity, especially during sleep, keep the body comfortably warm.

**Indications of Skin Activity.** — The skin is to be considered active when one has a good color, when he sweats rather freely, and when he is not easily chilled. The opposite conditions indicate inactivity, and when these prevail one should follow the suggestions given in the present chapter for improving the skin circulation.

**To Lessen Over-Activity of the Kidneys and Irritation of the Bladder.** — Since an abnormal flow of urine and irritation of the bladder are most frequently caused by an overwrought condition of the nervous system, relief in such cases is to be obtained by finding and removing the causes of nervous waste. These are considered at length in Chapters XII, XIII, and XIV. (In many instances the nervous energy wasted through eyestrain is the direct cause of these troubles.) If relief is not secured by this means, a physician should be consulted.

**To Relieve Shortness of Breath.** — Many cases of shortness of breath result simply from lack of exercise and are relieved by increasing the amount which is taken. When excess of fat is the cause, steps should be taken to reduce the weight (page 143). In cases that result from diminished lung capacity, forced deep breathing combined with vigorous exercise will be found helpful. If the condition depends upon some abnormal condition of the heart or blood, a physician should be consulted.

**To Remove Dandruff.** — Cover the scalp with a layer of olive oil, using a medicine dropper for the purpose, and rub it well in with the fingers. After three or four hours, wash the scalp with a lather made from some good toilet soap and thoroughly rinse with pure water. The surplus water is now removed with a coarse towel and the hair dried. When the dandruff is very troublesome, this treatment may be given once or twice a week; but in mild cases once a month is sufficient.

**To Test the Urine.** *a. For albumin.* Fill a test tube half full of the urine and hold in a slanting position over a clear gas flame so that only the upper portion is heated. Heat until the top of the liquid boils, taking care that the flame does not strike the tube above the liquid. If the boiled portion of the urine becomes turbid and this turbidity does not disappear on the addition of a few drops of dilute acetic acid (10% solution), albumin is present. If the urine is alkaline add the acetic acid before boiling.

*b. For sugar.* To a test tube half full of urine add a few drops of a very dilute solution of copper sulphate and then add sodium (or potassium) hydroxide, a few drops at a time, until the precipitate which first forms dissolves and turns a deep blue color. Then gradually heat the upper portion of the liquid to boiling. If it turns an orange or a yellowish red color, the presence of sugar (dextrose) is proved.

If either albumin or sugar be present in the urine, a physician should be consulted. Even if the presence of these abnormal ingredients is not revealed by the above tests, it is well to submit a sample of the urine to a specialist for chemical and microscopic examination when any disorder of the kidneys is suspected.

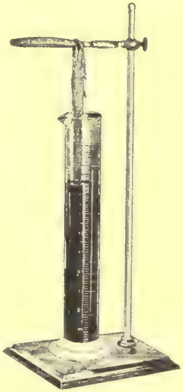

FIG. 45. — **Testing the Absorbing Capacity of Cloth.**

**To Test the Adaptability of Cotton and Wool for Garments Worn Next to the Skin.** — 1. Select equal thicknesses of cotton and woolen cloth and test their relative conductivity of heat as follows: Place a piece of cotton cloth over the end of the finger and apply to a hot steam pipe or radiator, or to a flat-iron heated for the purpose, noting with a watch the time required for the heat to be distinctly felt through the cloth. Repeat the experiment using a woolen cloth. Which is the better conductor? Which would let the heat pass more rapidly from the body?

To find some reason for the difference in conductivity, pieces of the cotton and woolen cloth may be examined with a simple magnifying glass. In which are the fibers most crinkly and in which the coarsest? Does this correspond to the difference in conductivity? Compare the difference in conductivity of a piece of absorbent cotton and the wool, using equal thicknesses and weights. (Determine by weighing on a sensitive balance.) Where there is the same fineness of mesh is there the same conductivity?

2. Test the *readiness* of cotton and wool to absorb moisture by suspending strips of equal width so that the lower ends extend into colored water. Let them remain suspended for some time, noting the height to which the water rises in each.

3. Test the *capacity* to take up water (absorbing power) by filling a graduated cylinder to a certain height and inserting the strip completely and giving it time to take up what it can. Then lift from the water and suspend over the cylinder (Fig. 45). Water which the strip is unable to hold is thus allowed to drop back into the vessel. The difference between the first reading and the second shows the amount absorbed by the cloth. It is of course necessary to take strips of the same size and weight.

4. Test their readiness to give up water by hanging them out to dry under exactly the same conditions.

State the results of the experiments with reference to the conductivity of heat and the ability to take up and give off water.

## CHAPTER XI

## METABOLISM AND SPECIAL LINES OF CONTROL

"A prudent man foreseeth evil and hideth himself, but the foolish pass on and are punished." — *Proverbs.*

HAVING considered in its different phases the general method of maintaining normal metabolism, we are in a position to solve easily certain bodily problems of special interest. Chief among such problems is that of obtaining a sufficient amount of bodily energy.

**A Pressing Need.** — The conditions of modern life are constantly making upon the efficient workman a greater demand for energy than his body is able to supply. The attempt to supply this demand leads to overwork and this to an enfeebled condition which further diminishes the energy output and invites disease. Although there is in many vocations a real need for shorter hours of work, the greater need for most people is an increased capacity for generating energy. This is accomplished in the main by attending to the conditions that affect the passage of materials through the body. By bringing the body to a higher degree of chemical vigor, by the careful adjustment of foods to bodily needs, and by attending to conditions that favor elimination, it is sometimes possible for one to more than double the energy which he can expend upon external work.

**The Principle of Utilization.** — Although the supply of energy depends fundamentally upon the quantity and kinds of food eaten and the amount of oxygen taken into the blood, the power supplied through these substances must be utilized in a proper manner by the body. Two men using equal amounts of the same foods and absorbing the same quantities of oxygen may differ greatly in their output of energy. While this may arise from a variety of causes, they all relate to one fundamental cause — the ability of the body to utilize in a proper manner the various substances taken into it. The person who is able to realize a large percentage of energy is one whose entire body is in such a condition that it works up perfectly the food and the oxygen and rids itself effectively of resulting wastes.

**Accumulating Waste and the Energy Supply.** — Perhaps the greatest loss of available energy arises from the accumulation of bodily wastes. Wastes which are present in the blood, lymph, and the cells interfere with the introduction of new materials. As with the stove or furnace so with the body. Only as the impure gases escape can the free oxygen enter, and only as the ashes and clinkers are removed is space provided for fresh fuel. The fires of life must necessarily smoulder when we permit wastes to accumulate.

If the accumulating wastes are of a harmful nature, and most of them are, the energy loss is still further augmented. Cell poisoning from this cause may be so great as totally to incapacitate one for work; in some instances to destroy life itself. Boiler-scale is not more wasteful of fuel nor dangerous in its way, than is accumulating waste in the human system. Further loss of energy is found in the actual obstruction which substances lingering too long in the body offer to the effective working of its various parts.

**Internal Friction.** — The mechanic knows how great an amount of energy may be lost in overcoming friction in machinery. If the bearings are not properly adjusted, or if there be insufficient lubrication, more energy may be spent in running the machine than in doing the work for which it is operated. The same is true of the human mechanism. Accumulating wastes give trouble in a number of ways. By clogging the capillaries,[1] they impede the circulation, thereby increasing the work of the heart. By stiffening the muscles, tendons, and joints, they cause movements to be performed at a great disadvantage. Deposits of fats often result from accumulating wastes, and these make a further draft upon the bodily powers. We may be quite sure that energy spent in operating the body itself cannot be spent in work, or in play, upon things outside of the body.

**The Sphygmomanometer and its Findings.** — Just how much energy may be spent in operating the body itself is difficult to calculate. A partial insight into the internal consumption and its variation among different individuals, may be obtained through an instrument (Fig. 46), known as the sphygmomanometer (sphyg′-mo-man-om′-e-ter). The sphygmomanometer is a device for measuring blood pressure, i. e., the pressure which the heart must exert upon the blood in the arteries in order to maintain the circulation. The heart, in pumping the blood, must develop a pressure equal to the resistance offered by the blood vessels, and this the sphygmomanometer measures.

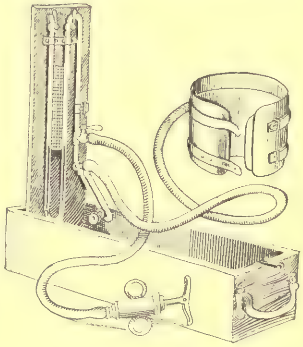

FIG. 46. — **The Sphygmomanometer,** an instrument for measuring the pressure of the blood.

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[1] Haig, *Uric Acid in the Causation of Disease.*

Since this pressure must vary with the circulatory resistance, the lower it is, from a health standpoint, the better, except in defective circulation due to heart weakness. In two persons of apparently the same physical condition the circulatory resistance may be a third higher in one than in the other, and this has a direct influence upon the available energy. Other things being equal, the one with the low resistance will have more energy for external work, because less is consumed in moving the blood.

One phase of the problem of securing sufficient energy is, therefore, to reduce internal friction as may be done by agencies that lower the pressure of the blood.[1] That circulatory resistance may be reduced through diet, attention to waste elimination, conservation of the nervous energy, reduction of surplus fat, and sufficient exercise is easily demonstrated.[2] It may be noted also that the removal of conditions that are responsible for the blood pressure will save energy losses in other ways at the same time.

**A Reward of Right Living.** — While the problem of securing the maximum supply of bodily energy involves practically all the phases of body metabolism, it depends upon other conditions only to a slight extent. Hence a discussion here of the practical methods of increasing the available energy could be little more than a review of the preceding chapters. Suffice it to say that the ability to realize the maximum of bodily energy comes through the attainment of splendid health. It is one of the rewards for the time and effort spent in perfecting the chemical processes, for the study and endeavor necessary to prevent waste accumulations, and for the restraints which must be enforced to keep out of the body substances of a harmful nature and to regulate the quantity of all materials to the bodily needs.

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[1] The reduction, through hygienic means, of abnormally high blood pressure serves the additional purpose of diminishing strain upon the heart and blood vessels.

[2] In a hygiene class of fifty, ten were found to have abnormally high blood pressures and hygienic measures were suggested for reducing them. During a period of two months an average reduction of 12 millimeters (Faught instrument) was accomplished, the greatest reduction being 25 millimeters and the least 5 millimeters.

**Overwork and Underwork.** — Though much depends upon the actual demand made upon the body for energy, the maximum supply is obtained neither by overwork nor underwork. Overwork means the using up in a single day of more energy than the chemical forces are able to generate, the extra consumption coming from the reserve supply. It means also the using up of so much energy for external work that an insufficient amount is left for running the vital processes. This is, indeed, the most serious phase of overwork. The drawing off of energy that should be used in the vital processes interferes with the agencies through which the latent power of food and oxygen are transformed, and this diminishes the supply of energy for the days following. Hence overwork defeats its own purpose, causing the one practicing it to lose his capacity for achievement. Even occasional overwork must do harm unless conditions for complete recovery be supplied after each transgression.

To work up to one's limit, on the other hand, is a most important method of increasing the energy supply. The demand for more energy is a powerful stimulus to the organs upon which the energy supply depends, and the great workers of the world have been those who have put themselves to the test. Laziness is weakening, and those who are too careful about their expenditures of energy are liable to have their meager supply still further curtailed. The scriptural statement, "To him who hath it shall be given, and from him who hath not shall be taken away even that which he hath," applies with special force to the energy supply of the body.

**To Improve the Complexion.** — Another problem whose solution depends upon the control of conditions relating to the passage of materials through the body is that of securing a good complexion. This is not altogether a woman's problem, but when reduced to the last analysis is one of almost equal interest to both sexes. Aside from its æsthetic value, a good complexion indicates health and vitality and is one of the points upon which others base their opinion of our capacities. The good complexion is a natural accompaniment of good health and depends primarily upon two conditions — a clear skin and a good circulation of blood through the skin. These in turn depend upon conditions affecting metabolism as set forth in the preceding chapters.

**Clearness of Skin and Waste Accumulation.** — The greatest enemy to clearness of the skin is imperfect elimination of waste. If the solid wastes are not effectively removed through the natural channels — the liver, kidneys, and bowels — these tend to accumulate in the skin. Blotches, sallowness of the skin, and skin eruptions are the results of such accumulations. To clear the skin the chemical processes of the body must be looked after and attention given to all those agencies that favor the elimination of waste. Especially must there be a free evacuation of the bowels each day.

**Foods and the Complexion.** — Foods that are difficult to digest, or that cause disturbances of the digestive organs, usually have a bad effect upon the complexion. A diet should be selected, if possible, that offers no special difficulty in the matter of digestion. Tea, coffee, meat, and other substances containing purin bodies, are likely to discolor the skin from the unnecessary waste which they introduce, and if there is any tendency toward acid accumulation, acid-containing and acid-forming substances may cause eczematous eruptions. The effect of all of these, however, varies with the chemical activity of the body, becoming more serious as the body loses its power to oxidize the harmful to harmless wastes.

**Skin Activity and the Complexion.** — The methods already discussed (page 198) for making the skin more active as an organ of elimination have also the effect of increasing its beauty. The color of the skin comes from a good flow of blood through its capillaries. Hence exercise, the warm bath and the cold bath taken with due precautions, massage, and the olive oil rub, since they improve the skin circulation, are the means of securing that delightful color tone which is the life of the complexion. Thus again are the simple things, which we do primarily for the improvement of health, made to serve an additional purpose.

**The Truthful Complexion.** — The good complexion has physiological and social value in that it serves as a sign or badge of a healthful body. The body speaks, as it were, through the good complexion, saying to the observer, "I am well; I am strong; I have rich, pure blood; I am a good animal; I know and feel the joy of living." And when the attractive complexion is the result of good health, these things are spoken truthfully. There is no deception or misrepresentation. Herein lies the chief advantage of the natural complexion over the artificial effects secured through the application of questionable substances to the face.

**Avoidance of Diseases Resulting from Impaired Metabolism.** — A large number of ailments, including rheumatism, gout, diabetes, Bright's disease of the kidneys, arterio-sclerosis and other affections of the blood vessels, and certain diseases of the heart, liver, stomach, and skin, have been found to depend, in numerous instances, upon the improper working up and utilization of materials by the body, i.e., upon impaired metabolism. Though authorities do not agree as to the specific cause or causes of these diseases — some claiming that they result largely from the accumulation of uric acid, others that wastes in general are responsible for their origin, and others still that they are induced through a variety of abnormal conditions — all agree in the belief that their development depends upon injury from the materials with which the body has to deal. They result from failure of the body to use to advantage what is put into it, and if such failure can be obviated they do not appear. Proof that the causes leading up to these diseases may be avoided is found in the methods employed in the cure of such diseases after they have developed.

**The Physician's Attack.** — For decades physicians have recognized the importance of diet in the treatment of diseases dependent upon impaired metabolism. Through dietary restrictions, both as to the kinds and the amounts of foods, patients are limited to what their bodies can utilize to good advantage. In conjunction with dietary restrictions, the organs of elimination are stimulated, both through hygienic means and through drugs, in order that the body may rid itself of poisonous wastes. A third point of attack is found in the hygienic means — exercise, outdoor life, etc. — which improve the chemical processes of the body. Through the application of these principles, disorders of the kidneys and other bodily organs, at one time considered incurable, now yield to treatment.

If by hygienic measures the diseases resulting from impaired metabolism can be cured, how much more potent must be the same measures when applied before bodily structures have been altered! That these diseases can be prevented there is no longer any question. Our problem now is to secure a wider distribution of the knowledge of the means of prevention and greater earnestness on the part of people in the application of this knowledge.

**The Need for Prevention.**—Statistical reports show that something like 350,000 Americans, between the ages of 30 and 75, die each year from diseases resulting directly or indirectly from impaired metabolism. Many of these are invalids for long periods before they finally succumb, suffering great distress and placing a burden upon their friends and relatives. It is the victims of such diseases who swell the crowds at our popular watering places and health resorts, seeking often in vain for the restoration of health. Who can estimate the suffering, the mental anxiety, the financial loss, even, resulting from the afflictions of so large a class?

What it means to the individual can be more easily computed. Suppose a skilled workman at the age of fifty develops Bright's disease and dies. This man, let us say, has an earning capacity of $2,000 per year and a constitution which, under a regulated mode of life, would remain efficient to the age of 70. His premature death means to his estate a gross financial loss of $40,000 and to himself failure to realize the last period of his life. Such is the penalty which many must pay for the careless, instinctive mode of life which the majority of people are blindly following.

**On the Increase.** — Reliable statistics show that whereas the death rate among the people of the United States under 40 years of age, especially among those under twenty, has been greatly decreased, there has been a decided increase among those above 40. This increase is traceable, moreover, to the greater prevalence of heart and kidney disorders (Fig. 47) and to other diseases dependent upon impaired metabolism. That it is not due to the larger number who are saved from infectious diseases of a younger period is shown by the fact that there has been no such increase in England and Wales where there has been a corresponding decrease in the death rate of young people.

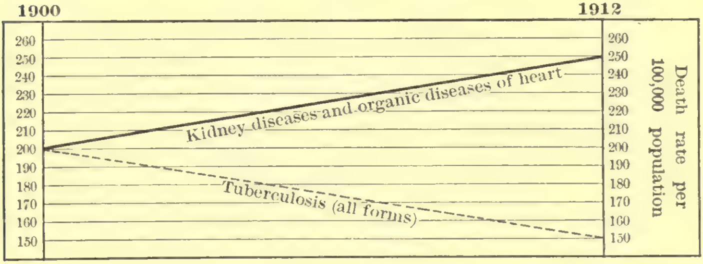

FIG. 47. — **Increase of Death Rate from Certain Diseases** resulting from impaired metabolism, and decrease of tuberculosis, in the registration area of the United States in twelve years. While we should not diminish our efforts to prevent tuberculosis, we should increase our efforts to secure a greater control over our chemical processes.

Nor are the causes for this increase difficult to find. They lie for the most part in the greater accentuation of conditions that interfere with the chemical processes of the body. The number of people who are overstraining their nervous systems and who are reducing their chemical activities through uncorrected indoor habits is greater than ever before in the history of our country. There has also been an increase in the use of acid-containing substances — citrous fruits and of other fruits containing large per cents of acids — and there has been little or no diminution in the consumption of meats and alcoholic beverages. With the increase in the causes making for these diseases there have been no counteractive measures — no campaign of education relative to the prevention of the chronic, non-communicable diseases common to middle life and old age.

**Danger Signals.** — The diseases resulting from impaired metabolism do not come on suddenly but arise from conditions of long standing. On this account they are easily detected in their encroachments and as easily controlled through shifts in diet and habits of living. Suggestive of such control is the relation which some have experienced between the eating of meat and the development of rheumatic pains. When they eat meat in any but very small amounts they experience mild attacks of rheumatism. When they studiously avoid meat they have no rheumatism. Hence they may choose between freedom from rheumatism and the use of meat. Others find that the rheumatic pains appear from other causes, such as overexercise, the use of acid fruits, and the overuse of sugar. But whether from meats or other causes, the pains serve as danger signals, giving timely warning of waste accumulations and other conditions liable to injure the cells.

But there are other signals of approaching trouble. The tendency to obesity is such a signal and another is a bad color of the skin. Shortness of breath, high blood pressure, swelling of the feet and ankles on standing, weariness from slight physical exertion, acidity of the stomach, and constipation, may all be regarded as danger signals. Most frequently, perhaps, are the warnings through some indisposition of the nervous system, such as sick headaches, or the frequent occurrence of disagreeable states of mind.

In addition to the foregoing indications, the physician has a special means of detecting encroachments of these diseases through the composition of the urine. By chemical and microscopic examination of this liquid, the presence of abnormal substances is detected and, in the same manner, the physician frequently gets a clue to the most effective mode of treatment. It is estimated that sixty per cent of the diseases resulting from impaired metabolism would be prevented if everyone past middle age would submit periodically to a thorough physical examination by a competent physician and then follow such an hygienic régime as the examination shows to be necessary.

**Length of Years and Old Age Efficiency.** — Not the least of the problems to be solved largely through control of conditions affecting metabolism is the double problem of increasing the span of life and avoiding the inefficiency common to old age. Life is short enough at best. Since it is necessary to spend the first third in preparation, it is cruelly sad to have the last third lopped off by death or deprived of its rightful fruition through senile inefficiency. Physiological science has demonstrated that neither the termination of life under 80 or 90 years nor the inefficiency which is attributed to old age are in the natural order of events, but the results rather of improper methods of living — the oft repeated violation of laws of health. The saying that "most people dig their graves with their teeth" is not far from true if we apply the phrase in the broader sense of body metabolism.

**Causes of Old Age Inefficiency.** — The beginning of the end with most people past middle age is the termination of an unhygienic mode of life in some disease. The same causes account for the years of inefficiency which sometimes precede the final termination of life. The problem of waste elimination becomes more difficult with advancing years, though many old people persist in their use of meat, tea, coffee, and other harmful substances, and in eating more than their bodies can properly utilize. In many instances constipation is permitted, and this causes waste that should be thrown off by the bowels to be taken up by the blood. This, according to Metchnikoff, is a chief cause of arterio-sclerosis (artery hardening), the arch enemy of length of years and of efficiency. Again there is a tendency among old people to refrain from physical exercise — to become less active generally — and to neglect the essential hygiene of the skin. It is but natural that an old person should lose his power to work and enjoy if he persists in violating the laws of his body. Intelligent direction of the agencies that influence metabolism is largely the solution of the problem.

**The General Method.** — Length of life is attained by putting into practice during all of its periods an efficient system of health control. Life protected from the agencies that would destroy it, goes on to its natural termination, which is described as a phenomenon similar to that of falling asleep. In early life the greatest liability is from diseases caused by germs, but after middle life the main struggle is with the diseases that result from impaired metabolism. Each period of life must be properly lived. Youth is the time to lay the foundation for long life which is efficient to the end.

**Activity Vital.** — While the old person should diminish his activities, he must never permit himself to drift into a period of idleness, either of body or of mind. During the preceding years the body machinery has become adjusted to a condition of activity and any radical change in this respect is almost sure to impair the chemical processes. When the fans that drive the fires of life stop, the fires themselves cannot much longer continue! Many an old person has shortened his life by taking full advantage of what for him was a well-earned period of leisure. Nature takes no account of what we deserve for previous performances, but enforces without mercy the violation of the law of exercise. *The price of health and efficiency in all periods of life is effort.* No person, old or young, must overlook this essential fact.

**General Summary.** — In the last five chapters preceding this, we have considered the problems upon whose solution depends the maintenance of normal metabolism. These are,

1. The maintenance of such a degree of bodily vigor that the cells perform their chemical activities to good advantage (Chapter VI).
2. The determinations of what materials shall enter the body and the adjustment of foods to bodily needs and bodily conditions (Chapters VII and VII).
3. The maintenance of efficiency on the part of the digestive organs (Chapter IX).
4. The supplying of conditions favorable to the elimination of waste (Chapter X).

Success along these lines means no less than the control of our chemical processes — a kind of control of the greatest importance. Through its exercise we increase our bodily energy, secure a healthy complexion, avoid diseases resulting from impaired metabolism, and provide for efficiency in old age. Additional aid in securing chemical control is obtained through a proper conservation of the nervous energy. This study is begun in the chapter following.

**Exercises.** — 1. Upon what does the energy supply of the body depend? What disadvantages and dangers result from a low supply of energy?

2. In what different ways is the supply of available energy curtailed?

3. How is blood pressure measured? Explain the significance of abnormally high blood pressures. Through what hygienic means may the blood pressure be reduced?

4. Explain the relation of overwork and underwork to the production of bodily energy.

5. Give general directions for increasing the energy supply.

6. State the value and the meaning of a good complexion. Upon what bodily conditions does it depend? How are these conditions secured?

7. Name examples of diseases resulting from impaired metabolism. How do these diseases originate? State the meaning of the saying, "Most people dig their graves with their teeth."

8. How does the physician cure diseases resulting from impaired metabolism? What lesson of prevention is thus taught?

9. Account for the increase of these diseases in the United States.

10. Enumerate the signs of their encroachment. How are such encroachments counteracted?

11. How may one's natural appetites, inclinations, and desires act as causes of these diseases?

12. What are the main causes of inefficiency in old age?

13. State the conditions for the attainment of length of life and old age efficiency. Why must the old person keep active?

14. Summarize the fundamental conditions for preventing the weakness and the diseases that originate through chemical causes.

## Health Work

The student may now begin with some degree of definiteness the work of relieving physical defects and ailments that depend upon chemical causes. In finding the solution for personal problems, however, care must be exercised that the remedies employed do no harm. The suggestions which follow are to be considered in relation to the discussions in the text.

**To Increase the Energy Supply.** — With students the item requiring chief attention is usually that of physical exercise. Because of the close relation of energy production to physical vigor, exercise affords in most cases the main point of attack. Other conditions of course need looking after, such as thorough elimination, conditions affecting the supply of oxygen, and avoidance of nerve strain. The diet should incline toward the purin-free substances, and alcohol, tobacco, tea, and coffee should be omitted. Suggestive of the general method of procedure is the fact that a good supply of energy is a natural accompaniment of good health.

**To Improve the Complexion.** — Though dependent upon health in general, the good complexion depends most directly upon the processes of elimination. The skin, the lungs, the kidneys, and the liver must all work efficiently, and especially must the intestines discharge their wastes regularly and effectively. Outdoor exercise for increasing the red corpuscles, full breathing as an aid to oxidation, bathing and exercise for invigorating the skin, good digestion, avoidance of rich foods and foods that disagree, and relief from nerve strains, comprise most of the natural agencies. The leaving off of cosmetics is also an aid to success through hygienic means.

**Avoidance of Rheumatic Pains.** — Rheumatic pains which do not depend upon germ attacks are the result in most cases either of accumulating wastes or of a condition of acidity, and are to be avoided through agencies that prevent these conditions. Activity of the skin, daily and complete evacuations of the bowels, adjustments of diet to avoid acidity, temperance in the use of all kinds of food, and the avoidance of prolonged chilling and of overwork are the main points to be considered. (Acute rheumatism, which is an infectious disease attended by fever, should receive the attention of the physician. He should also be consulted about rheumatic pains in the muscles and joints which are not easily relieved through hygienic means.)

**To Reduce Blood Pressure.** — As stated in the text, blood pressure which is too high puts a strain upon the heart and the blood vessels and consumes energy internally which could otherwise be spent upon external work. While the average blood pressure for adults is equal to the pressure exerted by a mercury column 120 millimeters high, a pressure above 110 mm. may be regarded as unnecessarily high for one under 25 years unless he be of athletic build and habits. A reduction of blood pressure is usually accomplished through physical exercise, a more careful adjustment of diet to bodily needs, and relief from constipation, if this condition be present. Excess of food must be avoided and purin-bearing foods, especially lean meat, used in limited amounts. High blood pressure also depends upon a degree of nervous tension. Hence it is necessary that all kinds of nerve strain be avoided and that the use of substances, such as alcohol, tobacco, tea, and coffee, which excite the nervous system, be discontinued or greatly curtailed.

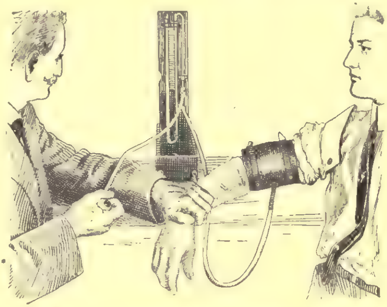

FIG. 48. — **Measuring Blood Pressure** by the method of palpation and with a mercury gauge.

**To Measure Blood Pressure.** — A special instrument (the sphygmomanometer) is required for this purpose, and the manufacturers supply full directions for its use. In making tests it is unnecessary to bare the arm, though best to remove any heavy clothing, such as the coat. After attaching the arm band (Fig. 48) and connecting this with the gauge, the pulse is found at the wrist. With a finger on the pulse, air is pumped into the rubber bag until the pulse beat is no longer felt.[1] Air is then permitted to escape until the pulse again becomes perceptible, and at this instant the height of the mercury column is read. This is recorded as the systolic blood pressure (direct pressure from the ventricle) and this for observational purposes is sufficient. (The air from the small pump in seeking to escape presses both upon the gauge and through the rubber bag upon the tissues of the arm. This pressure soon becomes sufficient to close the artery and stop the flow of blood from the heart, the amount being shown, at the same time, by the gauge.)

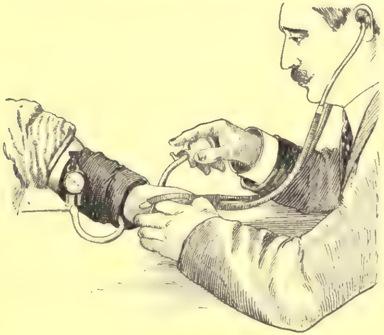

FIG. 49. — **Measuring Blood Pressure** by the method of ausculation and with a diaphragm-dial gauge.

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[1] Instead of depending upon the sense of touch for detecting the pulse it may be detected, by means of a stethoscope, through the sense of hearing (Fig. 49). This method, known as the method of ausculation, is considerably more accurate than that of touch or palpation.

All observations should be made as nearly as possible under the same conditions, since fatigue, nervous excitement, the presence of food in the stomach, and certain drugs, are liable to affect the pressure. The test should not be too prolonged, for the interruption of the circulation will of itself cause changes in the pressure.

**To Grade the Health.** — To ascertain more definitely the extent to which the health may be consciously controlled, it is recommended that the student keep a record of his physical condition and the causes that affect it for a period of at least a month. He should give himself each day a grade such as his physical condition merits, basing his estimates chiefly upon the health indications as set forth on pages 23–25. The initial grade should not be too high — for the average student not over 80%. The data thus obtained may then be plotted to show the health variations and their causes in graphic form, using coördinate (cross-ruled) paper for the purpose, as shown in Figure 50.

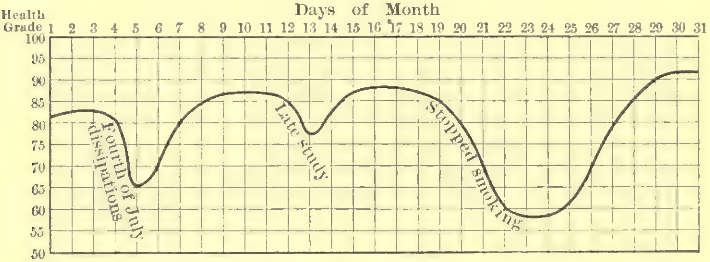

FIG. 50. — **A Health Record** for a period of one month. Although stopping smoking appeared to cause a temporary lowering of health, the greater rise following the period of depression made the change amply worth while.

# CHAPTER XII

## CONTROL THROUGH NERVOUS CONSERVATION

WHETHER the body be controlled through the method of instinct (page 36) or through instinct guided by intelligence, the basis of control is the nervous system. Fundamental, therefore, in the maintenance of good health is a knowledge of the means through which this system is properly cared for and its powers utilized to the best advantage.

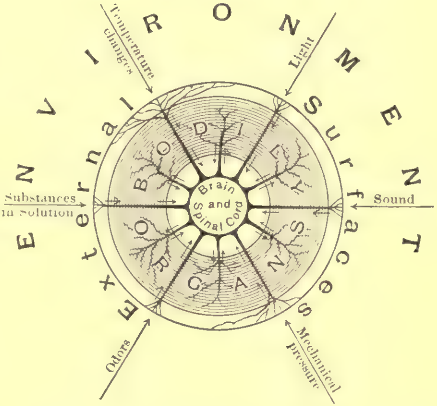

FIG. 51. — **The Nerve Automaton.** The diagram shows the general arrangement by which stimuli acting upon the body surfaces can excite the brain and spinal cord and, through these, the bodily organs.

**The Nerve Automaton.** — In its mode of operation the nervous system must be looked upon as an automaton which is set into action by the internal and external influences to which the body is subjected and which in turn sets into action the bodily organs (Fig. 51). The arrangement of its structural elements, the *neurons*,[1] is such as to receive stimulation at all the body surfaces and to transmit this stimulation, through impulses, to all the bodily organs. The neurons, like the wires in a telephone system, connect the different portions of the body with a central station (the brain and the spinal cord), and these provide connections through which excitation at one place may cause action at another. As telephone wires are massed together to form cables and coils and are connected with switchboard and batteries, the neurons are massed to form nerve trunks and ganglia and connect with one another to form the complicated structures of the brain and spinal cord.

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[1] The term neuron is applied to the complete nerve cell — the cell-body with its branches, the dendrites, and the axon or fiber. The neurons form the nervous system and are the active agents in carrying on its work.

**Nervous Energy.** — Stored away in the batteries of the telephone system is the peculiar power which makes its operation possible. This is the potential energy of chemical affinity. Every electrical movement over the wires makes a draft upon this energy, and when the batteries are exhausted, they must be either replaced or replenished. The nerve automaton is an energy transformer of an even more delicate nature. The nervous impulses, in some ways similar to electrical currents, though differing from them in their essential nature, subtract from the general reservoir of nervous energy and this,[1] as in the case of the batteries, must be replenished. During sleep and rest the nerve cells are recharged, as it were, to be again discharged during the periods of activity.

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[1] The chemical changes upon which the activity of the neurons depends are so slight that the view has gained ground that nerve cells are practically inexhaustible. In experiments with the excised nerves of frogs, it is impossible to detect changes in the nerve fibers by ordinary means. Such nerves, however, soon cease to transmit impulses if deprived of oxygen, and Waller has found indications of the production of carbon dioxide. Hence we can hardly escape the conclusion that functional activity of the nerve fibers is attended by a slight amount of oxidation. With cell-bodies, however, the proof is conclusive. Hodge has found that the nerve cells controlling the wing muscles of bees show microscopic differences when examined in the morning, after prolonged rest, and late in the day, after prolonged flight. Our knowledge of the law of the conservation of energy, as well as our feeling of exhaustion from purely mental work and of refreshment after sleep, also teach that the nerve cells, like the cells of the muscles, derive energy through chemical changes.

**Meaning of Conservation.** — The term conservation, as applied to nervous energy, has reference both to its development and use. On the one hand, the individual needs to make a right use of the agencies, such as exercise, work, proper food, and sleep, that tend to develop and regenerate nervous power; and on the other hand, he must avoid things and conditions that waste nervous energy or employ it in ways that have no value. As in the handling of money, one may by reckless spending, arrive at bankruptcy, or by legitimate investments, he may provide income without diminishing his capital stock. Nervous energy is to be spent, but not wasted. It is to be invested, but not in such a manner as to endanger a necessary reserve. In keeping with this principle, we shall consider the general subject of nervous conservation under two heads — prevention of nervous waste and agencies that improve the nervous system.

## I. The Prevention of Nervous Waste

A prime requisite in the avoidance of nervous waste is the ability to recognize conditions that show when such waste occurs. The signs which characterize an undue loss of nervous energy include a diminished capacity for all kinds of work and special symptoms, many of which are of a distressing and some of an alarming nature.

**The Meaning of Nervous Disorders.** — Positive indications, not only that the nervous energy is being wasted, but also that in many instances the body reserve is being reduced, are found in the so-called nervous disorders. These may be grouped roughly into two classes — those that are mild and those that are serious. The mild disorders of the nervous system include neurasthenia (nervous exhaustion), headache, neuralgia, insomnia, hypochondria (the suffering from imaginary pains and diseases), melancholia, the tendency to worry, and the persistence of unhappy states of mind. The serious disorders include chorea (St. Vitus's dance), epilepsy (fits), paralysis, palsy, and the various forms of insanity.

In their order of development, the mild disorders of the nervous system appear first. These, therefore, may be looked upon as danger signals, giving warning of encroaching ailments of a more serious nature. When recognized as such and the proper means adopted for preventing further waste, the serious disorders usually do not appear.

**Functional Disturbances and Nervous Waste.** — Since the proper working of the bodily organs is dependent upon an adequate nerve supply, their failure to function as they should is suggestive of nervous waste or a misdirection of the nervous energy. On this account the degree of efficiency with which an organ does its work may serve as a reliable nerve indicator. With some, such an indicator is found in the heart. If the heart beats too rapidly, skips beats, or is otherwise irregular in its action, or if there be a feeling of pain or discomfort in the heart region, the person is made aware that his nervous system is for some reason overtaxed. With others the stomach is the organ that gives trouble when the supply of nervous energy is insufficient for all the demands made upon it. Attention has already been called (page 191) to the effect of nervous irritation upon the work of the kidneys. In addition to functional disturbances of particular organs, bad general conditions also result from nervous waste. An impoverished condition of the blood, known as anemia, may be caused by nervous depletion, as may also a persistent, run-down condition, sometimes referred to as "lack of vitality." [1]

**Nerve Leaks.** — One whose work is to keep a reservoir filled with water knows that his task is greatly lessened by keeping the leaks closed (Fig. 52). By this means the water is applied to its intended purpose and waste is avoided. A nerve leak may be defined as any cause that leads to the waste or misdirection of the nervous energy. Obviously the first step toward the conservation of the nervous energy is to close, as far as possible, all nerve leaks. These present great variety, and for convenience may be considered under the following heads: Irritations of sensory nerves, mental and emotional wastes, social irritations, sexual perversions, drug effects, and general conditions.

FIG. 52. — **A Leaking Water Tank.** The difficulty in keeping this reservoir filled is no greater than that of keeping a reserve supply of nervous energy when serious nerve leaks exist.

**Irritations of Sensory Nerves.** — By irritations of sensory nerves is meant the undue excitation of any of the millions of tiny neurons connecting the brain and spinal cord with body surfaces (Fig. 53). These terminate in touch corpuscles in the skin, in the mucous linings of the air passages, food canal, and other places, and in the sense organs of sight, taste, hearing, and smell. Their purpose is to convey the impulses, or signals, through which the brain receives information from the outside world and through which the nervous system is largely set into action. Under normal conditions these neurons serve their purpose in an economical manner, but under abnormal conditions there is an excess of signaling which becomes a source of great waste. From this cause special nerve tracts are overworked and the nervous system as a whole becomes exhausted. An example

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[1] In medical practice patients are frequently found who do not respond to the usual remedies. Formerly such patients were said to be lacking in vitality or recuperative power. While the terms "vitality" and "recuperative power" appeared satisfactory to the laity and to a class of physicians, they were not satisfactory to physicians interested in the causes of disease. Why should certain persons be lacking in vitality? Study and investigation have shown that this condition is due largely to an exhausted state of the nervous system, the result of some form of nervous waste. When the causes of the waste are removed, such persons respond to treatment and recover rapidly. Indeed, since most drugs must act through the nervous system, we should expect their effect to be more or less uncertain when this system is impoverished.

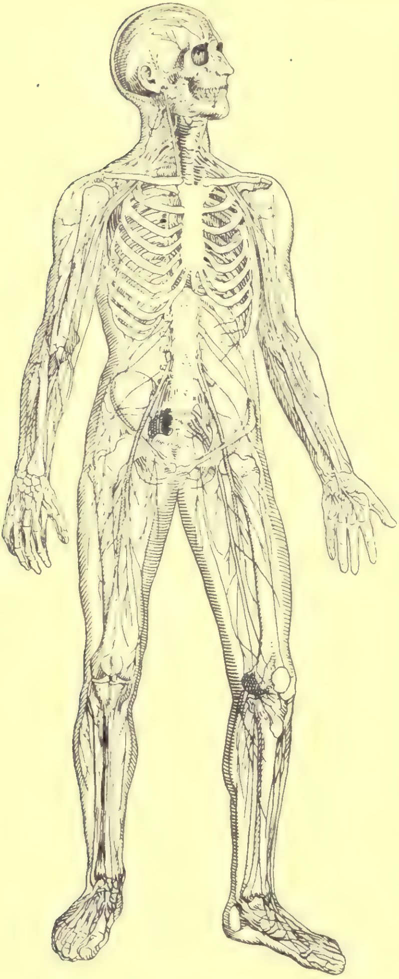

FIG. 53. — **The Peripheral Nervous System.** The illustration shows many of the nerves whose overstimulation wastes the nervous energy. (Copy of a Froshe Anatomical Chart published by A. Nystrum, Chicago.)

of such wasteful irritation is found in the familiar corn on the toe.

**The Corn on the Toe; an Illustration.** — The corn in itself is a small matter, but on account of its connection with the nerve automaton, it is an affair of the whole body. Through the connection of the neurons from the corn with other neurons, impulses originating at the toe, reach the spinal cord and the brain, and through their effects upon these organs, stir up and exhaust to some degree the entire nervous system. The cumulative effect usually becomes so disagreeable that relief is sought for the afflicted member. Such is Nature's method of defending the different parts of the body.

Unfortunately the sensory irritations cannot always be so directly referred to their cause. In many instances there is confusion in the signaling, so that a message of distress from one part of the body is treated as though it came from another and relief is misdirected. An instance of such is the neuralgic pain caused by decaying teeth supposed to be sound, and another is the headache due to eyestrain when one is unaware that the eyes are being overworked.

**Kinds of Sensory Irritations.** — Irritations of the sensory nerves are of many kinds and have to do with divers conditions to which the body is exposed. They include mechanical interferences such as come from misfitting clothes and foot-wear, the bites of insects, and the impinging of foreign substances upon delicate membranes. They include diseased conditions of the body surface, such as boils, infected sores, decaying teeth, enlarged tonsils, adenoids, and the various kinds of catarrh. They also include strain that may arise from overuse of the eyes or other sense organs, and abnormal bodily conditions, such as sprains and rheumatic joints. Some of these can be relieved by the individual himself; others require the aid of the physician or surgeon. While such relief is conducive to comfort and activity, its main value is in the saving of nervous energy.

**Sensory Irritations and the Mild Nervous Disorders.** — Most of the mild disorders of the nervous system, as well as some of the more serious ones, are traceable to sensory irritation. Headache in the majority of cases is the result of eyestrain and is relieved through removing this condition. Neuralgia of the face may result from eyestrain, from decaying teeth, or from pressure due to the closing of small cavities connected with the nostrils. Nervousness may result from any and all kinds of sensory irritation, a chief cause also being strain from the use of the eyes. Insomnia has an almost direct relation to sensory irritation; even the influence upon the nerves of ordinary light, faint sounds, and the overheating of bed-rooms are factors in keeping one awake. On account of the very close relation of eyestrain to disorders of the nervous system, special attention is given to this subject in the chapter following.

**Wasteful Brain Activity.** — Under normal conditions and with a good reserve of bodily health, hard mental work may be carried on without serious exhaustion of the nervous system. But under conditions of excitement or strain, mental work becomes a wasteful process. Mental activity calls for an increased supply of blood to the brain, and the disturbed circulation may itself be a source of irritation, causing nervousness and interfering with sleep. The remedy, of course, is to carry on the brain work with as little excitement as possible, and to counteract the disturbed circulation with suitable exercises, such as walking. It should be noted, however, that a certain amount of zest or enthusiasm is necessary to the best work and that mental alertness is implied in the assumption of any kind of responsibility. Though one should not suppress activities that make for a high grade of efficiency, it is well to remember that periods of intensity call for reciprocal periods of relaxation and rest.

**Emotional Leaks.** — Intense emotional states may become nerve leaks of a most serious nature. The emotions are less under control than are the intellectual processes and have a tendency, when once started, to run on of themselves. Of the pernicious effects of malice, envy, and jealousy, and of the destructive effects of anger much has been written and more remains to be said. Control of the emotions has, indeed, been a chief problem since prehistoric days, but the main argument advanced for such control was the protection of those toward whom the bad feelings were entertained. We now understand that the chief loser is the one who indulges the intense emotions and usually not the one toward whom they are directed. To him belong the nerve leaks and his is the nervous waste. Self-interest, even more than altruism, demands that we control our emotional states — suppressing those that are harmful and cultivating those that are beneficial (Chapter XIV).

**High Tension Loquacity.** — In many instances the brain and nervous system are "keyed up," so to speak, to too high a degree of tension, this condition being the result in some instances of the general mode of speech. Rapid talking and the habit of monopolizing conversation develop nervous strain and are exciting to the emotional states. Things, moreover, are likely to be said which from afterthought cause worry, while the talking in itself requires a greater outlay of nervous energy than is generally supposed. Then, as a social instrument, the tongue may become a nerve leak which causes nerve leaks in others. "Behold how great a matter a little fire kindleth." It is indeed to be regretted that control of this member is not more easily accomplished. Helpful in breaking the habit of over-rapid as well as an improper use of the organ of speech, is the cultivation of the art of being an *agreeable* and *appreciative* listener.

**Social Irritations.** — An exciting cause of worry, fear, anger, and other wasteful states of mind is the everyday action and reaction of people upon each other — these becoming more intense the more closely the individuals are associated. In this connection certain natural tendencies, the inheritance from a barbaric age, need very much to be curbed. Boys are fond of teasing and bullying each other, some teachers are given to nagging their pupils, a few otherwise commendable women are terrible scolds, and very excellent men are liable to bluff and threaten on small provocation, though the effect of all such conduct is to excite wasteful states of mind. Harmony in social relationships is a factor in nervous conservation whose importance is not fully appreciated. In the home, the school, the shop — in all places where people work, play, or live together — a lack of harmony may so waste the nervous energy of those concerned as seriously to threaten health as well as happiness (page 413).

Though the remedy for social irritation is found in the application of the Golden Rule, its proper application under some conditions may be exceedingly difficult. War is sometimes necessary for the establishment of permanent peace, and it is sometimes necessary to assert rights in order to have these rights respected. Tact and the spirit of forbearance are, however, always helpful on occasions when the conditions of social harmony need to be established.

**Sexual Perversions.** — Although this is not a course on sex hygiene, attention must be called to the necessity for young men and women, and people in general, to become informed upon the nature of the sex instinct and the relation of the hygiene of the organs of reproduction to the general health. Aside from the very serious diseases that are spread from violations of social and hygienic laws pertaining to sex (pages 360 and 416), the chief harm arising from abnormal sexual excitation and practice is to the nervous system. The solitary habit, sometimes contracted by those in the adolescent period, dulls the mind and interferes with the normal development of the body; while the free indulgence of the sex instinct in any manner and at any period of life is a species of nerve waste which makes for physical and mental weakness, and even insanity.

**Effects of Drugs.** — Many substances known under the general name of drugs interfere in different ways with the normal use of the nervous energy. No drug has ever been discovered whose use enables the individual, in the long run, to employ his nervous system to better advantage than when natural agencies alone are depended upon. Some drugs have apparently done this for short intervals, but in the sum total of effects the result was nervous waste. Those who have tried drugs of different kinds and who, pleased with the first effects, have advocated the use of certain ones, have themselves been disappointed in the end — often after it was too late for nature to repair the damage. Though all drugs do not act in the same manner and though the same drug may act differently with different individuals, the indoor worker, much more than the outdoor worker, is liable to experience injurious effects. Especially is this true of the drugs in tea, coffee, and tobacco. While these injure outdoor people only to a slight degree, they very frequently exercise pernicious effects upon those whose bodies are less vigorous on account of indoor environment.

Drugs for the cure of disease are permissible (page 155), but it should be understood that at the time that the drug is accomplishing its desired end, it is also producing an effect which is undesirable. While the physician is the judge as to whether a certain drug is necessary and whether its benefits will be greater than its injury, many physicians make the mistake of giving medicines that are too strong and of prescribing drugs when patients need instruction in hygienic living. Bodily strength and vigor are the goals toward which the physician should aim and these are not attained through drugs. The drugs are at most temporary expedients, used for reëstablishing physiological adjustments which have been temporarily lost. They should be withdrawn as soon as it is possible for the body to function properly without them.

**Effects of Light.** — Many have observed that exposure to intense light increases nervousness, while darkened rooms and cloudy days have a restful effect upon the nerves. The only way by which light can irritate the nervous system is through the organs of vision. The light in the higher altitudes is much more trying to the eyes and, therefore, to the nervous system than that of the lower altitudes, the rays from the sun being less diffused or scattered. Light reflected from white buildings and from snow and the direct rays from electric lamps are also very trying to the eyes and nerves. Relief from nervous irritation on account of light is obtained through care of the eyes, including the services of the oculist. The wearing of colored or smoked glasses may serve as a temporary expedient, though their continued use is not advisable.

**Irritation from Heat.** — It has been observed that the peoples living in the warmer climates are inclined to be more excitable than those living in the colder regions. A nervous person is made more nervous by an overheated atmosphere, but experiences beneficial effects from moderate degrees of cold. The so-called "sun stroke" is a serious nervous condition, marked usually by unconsciousness, which is caused by the overheating of the brain. There is no question but that the nervous system is influenced to a large extent by temperature, heat increasing nervous irritability, and a moderate degree of cold acting as a natural sedative. Relief from heat irritation is obtained, first, by removing the other causes of nerve weakness, and, second, by avoiding overheated rooms in winter and making necessary adjustments during the months of summer (page 111).

**Effects of Moisture.** — Air which is lacking in moisture and also air which is overmoist both tend to waste the nervous energy. Air which is too dry irritates the nerves by the excessive evaporation which it causes from the skin and from exposed mucous surfaces, particularly those of the eyes and air passages, while excess of humidity has a similar effect by its interference with the regulation of body heat. The dry winter atmosphere of many schoolrooms illustrates the first condition and the sultry days of midsummer the second. The bad effects of both conditions are greatly modified by temperature, increasing as temperature rises and diminishing as it falls.

**Noise and Disorder.** — With certain delicately organized nervous systems, noise and disorder are especially irritating. Though one may to a large extent accustom himself to discordant sounds and to more or less disorder and confusion, the unnecessary impulses passing to the brain are a source of waste and should, if possible, be avoided. In the school-room, quiet and order are necessary that the pupils may conserve their nervous energies and work to the best advantage. They are also necessary in the office, counting room, and other places where mental concentration is desirable. Even in the shop and factory the best results are secured where order and system prevail and where unnecessary noise and confusion are eliminated. But in this connection we must distinguish between distracting sounds and the hum of industry. The latter often has a restful effect.

**The General Method of Prevention.** — To prevent undue loss of nervous energy we must remove the causes which unduly excite and irritate the nervous system and which lead to expenditures of energy that yield no adequate return. This, as shown in the preceding discussion, necessitates effort along several distinct lines. Sensory irritations of whatever nature must be prevented; habits, instincts, and the mental and emotional states must be brought under control; and physical and social environment which does not draw too heavily upon the nervous system must be provided. Practical suggestions upon this phase of the subject are found in the Health Work section and the in two chapters following.

## II. AGENCIES THAT IMPROVE THE NERVOUS SYSTEM

The essential condition in the conservation of nervous energy is the maintenance of a necessary reserve. Avoidance of wasteful expenditure is one phase of the problem; the other phase is that of supplying conditions that cause the nerve cells to maintain their natural vigor and efficiency. The nerve cells require exercise and they also require the reënforcement that comes from the healthy action of all the vital processes. Hence all conditions that improve the health tend to increase the amount of nervous energy which is generated. Certain of these, however, have specific effects upon the nervous system and deserve, on this account, more than passing notice.

**Sleep.** — Both mental and physical work have the effect of breaking down the protoplasm of the nerve cells faster than it is built up. During sleep the reverse process takes place. To reduce the period of sleep beyond a necessary limit is to weaken the brain and the general nervous system and to lessen their working force. Eight hours of sleep per day is very near the amount required by the average adult. A number of people require more and a few can apparently get along with less than eight hours. The greater the nervous waste during the day, the longer should be the period for sleep. Because of structural changes due to growth, children require considerably more sleep than do adults. Old people do not require more, but usually less, sleep than do those in middle age.

Is it possible for one to sleep too much? This question should be answered in the affirmative. After sleep has served its purpose an extra amount does no good but probably does harm — leading to waste accumulation in some and to excess of fat in others. Effort to reduce the period, however, can be successful only when one is able at the same time to reduce the nervous wear and tear to which he is subjected.

**Edison's Period for Sleep.** — Much has been said about Edison's ability to get along with very little sleep, requiring on the average not more than five hours per day. This remarkable record is explained on the ground that Edison is an unusual type of individual. In the first place he is practically free from the usual nerve strains. He is without eyestrain and his partial deafness prevents nervous irritation from sound. He has a temperament, moreover, which keeps him free from worry. He has also a remarkable constitution — an ancestral inheritance — which causes his nervous system to recover rapidly, and his habits of living are exceedingly simple.[1] Though many people doubtless sleep more than is necessary, very few, for physiological reasons, can keep up on the Edison allowance.

**The Fallacy of Late Study.** — Much has been said and written of the value to the student of late study — the "burning of midnight oil." While a few have, no doubt, attained scholastic honors by late study, the practice is to be condemned both from the standpoint of hygiene and of progress in school work. Late study, by exhausting the nervous system, straining the eyes, and undermining the health generally, incapacitates the student in time for efficient work. Those who have tested the late study plan in comparison with the plan of concentrated effort through shorter hours, are unanimous in their endorsement of the latter. Under ordinary conditions, ten o'clock is as late as any student should work, and those lacking in bodily vigor should retire at an earlier hour (Chapter XV).

**Insomnia.** — Insomnia, or sleeplessness, is generally due to some kind of nerve strain or to excitation of the brain. Students very frequently have trouble in getting to sleep after severe mental work carried late into the night. The result here may be due to eyestrain or it may be due to a disturbed condition of the circulation — too great a flow of blood toward the head and too little toward the feet, as shown by chilliness of the extremities. The obvious remedy in this case is the discontinuance of the night work and the substitution of light gymnastics (or walking) for the study. The relieving of chronic insomnia, however, is not always a simple matter, and conditions frequently arise in which the physician's services are necessary.

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[1] Dyer and Martin, *Edison, His Work and Inventions.*

**Food and the Nervous System.** — The nervous system, like all the other parts of the body, requires a sufficient amount of nutritious food. It was at one time thought that the brain required a variety of food different from that needed by the rest of the body, but this view is no longer held. The amount and the kind of food, however, does have much to do with the effective working of the nervous system. All have at times experienced a degree of stupidity as a result of overeating, and sometimes headache and mental irritation as a result of eating something difficult to digest. The essential purpose, so far as the nervous system is concerned, is accomplished when foods are taken in such amounts and varieties as work up to good advantage chemically, satisfy bodily needs, and produce no more waste than can be readily eliminated.

**The Necessity for Nerve Exercise.** — All the cells of the body demand use. If any of them go for long periods without exercise they pass through a degenerative process, called *atrophy*, and finally die. Nerve cells cannot escape this general law, and since the different kinds of nerve cells serve widely different purposes, they require different kinds of exercise. Ordinary physical exercise supplies one form of nervous activity from the fact that the muscles are under nervous control. Another form of exercise is supplied by the cultivation of the powers of observation and discrimination, since these bring into use the nerve tracts connected with the eyes, ears, and other organs of sense. And last and most important is the special exercise of the intellectual faculties and the performance of those forms of manual labor which require a close coordination of the brain and the hand. Everything considered, *the life which presents a large range of activities and interests, is the one which best supplies the varieties of exercise needed by the nervous system.*

**Value of Work.** — The nervous energy requires a natural outlet. Inactivity begets restlessness, unhappiness, and mental and physical conditions which are unprofitable and undesirable. For supplying this natural outlet some kind of work is necessary. Even the semi-invalid is better off with something to occupy his mind. The neurotic is less nervous with something to do, and hard work is sometimes a good antidote for the pernicious habit of worrying. The periodicity of the daily task is also helpful, since it regulates the life and forces upon the individual regular habits of eating, sleeping, and recreating.

Hard work, whether mental or physical, does not injure the nervous system, so long as it is carried on under hygienic conditions. One who, in doing his part in the world's work, keeps up bodily health and vigor need have no fear for his nervous system. The nervous disorders suffered by brain workers are either the result of strain or of the disregard of the fundamental laws of health. Many brain workers neglect the physical side of life, and by permitting the vital processes to become inefficient, suffer the inevitable results of waste accumulations in the body. Effective mental work cannot long continue without a full accompaniment of bodily vigor (Chapter XV).

**Relaxation and Rest.** — Unconsciously to ourselves the voluntary muscles are in a semi-contracted state during the most of the waking hours, and with many nervous persons the tension upon the muscles is much increased by their mental states. The result is nervous loss. Much relief is experienced and nervous energy saved for other purposes when the nerve cells cease to stimulate the muscles, even though this be for short intervals. To gain complete relaxation one must assume a reclining position, and chairs and couches suitable for this purpose should be about the home and the office. Many kinds of strenuous work, however, offer little opportunity for relaxation during their performance, and little time for rest at the close of the day. A just criticism of our industrial system is that it overworks the individual.

Proposed reforms for shorter hours are in the right direction and the eight-hour day should become the general custom. But even when this and other reforms are carried out, workmen themselves must learn to conserve their vital forces. Certain forms of recreation are vastly more wasteful of nervous energy than work, and there is very general failure to make a proper use of the one rest day in seven.

**Restful Surroundings.** — Since all kinds of sensory excitation tend to develop a condition of strain, an important means of nervous rebound is found in surroundings which, through the senses, act in a reverse manner upon the nervous system. To offset the effects of glare from city streets and the irritations from electric light, one may feast his eyes upon the restful scenes of the countryside, and to overcome the effects of discordant sounds he may listen to the song of birds, the murmurings of the water brook, or to pleasant strains of music. Perhaps in no one direction does well-directed effort count for more in securing these effects than in the equipment and decoration of the home. In the selection of furnishings and wall decorations and in the planning of the yard and other external features, no pains should be spared to secure conditions that rest and soothe the nervous system (page 266).

**Summary.** — Nervous conservation means the economical administration of the forces which control the body and adjust it to its environment, and which supply the basis for our emotional and intellectual life. To maintain a necessary reserve of nervous energy, one must make a proper use of agencies, such as sleep, food, exercise, and outdoor life, which, through their effect upon the nerve elements, the neurons, develop and regenerate the nervous power; and he must trace out and find the means of preventing all unnecessary and wasteful expenditures.

There is no other kind of conservation so important to the individual as the conservation of his nervous energy. Failure in this means disease, both of the nervous system and of the body in general; while success means health, efficiency, and conditions conducive to happiness. Other phases of this problem are considered in the chapters following.

**Exercises.** — 1. In what sense is the nervous system an automaton? In what sense is it more than an automaton?

2. By what two general methods is the nervous energy conserved?

3. Name some of the indications of nervous waste. Define a nerve leak.

4. How can nervous weakness cause functional disease of the bodily organs?

5. How may irritation of sensory nerves waste nervous energy? How may severe pain cause nervous exhaustion?

6. Enumerate the different kinds of sensory irritations. What are the advantages of relieving them?

7. What harm results from neglecting mild disorders of the nervous system?

8. What forms of brain activity are wasteful? Explain.

9. Of what special value in nervous conservation is emotional control?

10. What are the advantages of controlling the tongue?

11. Explain the relation of social harmony to conservation of nervous energy.

12. In what different ways does the use of drugs lead to nervous waste?

13. Through what means does intense light cause nervousness? How does temperature affect the nervous system? Why should noise and confusion be avoided in the school-room?

14. Enumerate the agencies that maintain and increase the vigor of the nerve cells.

15. State the purpose of sleep. Why do some people need more sleep than others?

16. Give general directions for preventing insomnia.

17. What hygienic conditions are supplied to the nervous system through regular work? What harm results from idleness?

18. What is the physiological need for a proper observance of the Sabbath? State the advantages of restful surroundings.

19. State the importance of nervous conservation.

## Health Work

Nervous conservation is a method of living, and its attainment depends upon the establishment of a variety of habits, some of which have already been mentioned. Regular habits of work, rest, and recreation; habits of temperance in eating and in speech, and the habit of abstinence from the use of all substances harmful to the body; habits of orderliness; approved habits of treating others and of responding to treatment received; and the sum total of habits which constitute character, all have a more or less direct bearing upon the generation of nervous energy and upon its economical use. Most important of all, perhaps, are the habits referred to in Chapter XIV, which determine the general attitude or trend of the mental states. In most cases also the establishment of an adequate system of nervous conservation depends upon the solution of one or more problems of a personal nature, such as follow.

**To Stop Nerve Leaks.** — Nerve leaks are stopped by removing their causes, but these present even more variation than the leaks themselves. In the removal of some causes, such as eyestrain and the presence of abnormal growths, the services of the specialist are indispensable; in others, such as irritations from the feet and losses through the emotions, the individual may accomplish the desired results through his own efforts. In many instances success is attained with difficulty — the so-called leaks are of long standing and time and persistent effort are necessary for their removal — and one is tempted to give up the struggle and to adjust himself to the abnormal condition. This is decidedly unwise, since the solution of other problems of health may depend upon the stoppage of the leaks.

**To Prevent and Relieve Headaches.** — Headache is usually the result of irritation of the nerves terminating beneath the skin of the head and it may be supra-orbital (over the eyes), temporal (in the temples), or occipital (at the back of the head), according to the nerves that are affected. While such irritations result most frequently from strain of the eyes (page 259), they also arise from nasal obstructions and, in rare instances, from irritations at the roots of teeth. Since the nerves are rendered more sensitive by wastes and toxins in the blood, contributing causes of headache are found in conditions, such as poor digestion, constipation, fatigue, and germ attacks, which are responsible for the harmful substances. To secure permanent relief from headache, all the causes upon which it depends must be discovered and removed.

To use headache powders or prescribed drugs, instead of seeking out and removing the cause of headache, is decidedly unwise. It is impossible for the drugs to deaden the pain without acting injuriously upon the entire nervous system. In many instances the use of drugs for stopping headaches has resulted in death. The natural method of securing temporary relief is through rest (especially of the eyes) and sleep. A cloth wrung from hot water and laid over the eyes is sometimes quite effective. If the digestive disturbances are the cause, a drink of hot water is more helpful.

**To Prevent Neuralgia.** — Since neuralgia of the face and other portions of the head results in most instances from sensitive teeth, eyestrain, or obstructed nasal cavities, the condition is relieved and prevented by the removal of these causes. First thought, perhaps, should be given to the teeth, the dentist making a thorough examination. If the neuralgia persists after the dental irritations have been relieved, the eyes should be carefully tested, unless the nostrils be closed or there be trouble from catarrh. In this case one may consult a nose and throat specialist or the family physician. Attention should also be given to the general health and especially to the conservation of the nervous energy.

**To Relieve Nervousness.** — One may be said to be nervous when he is irritated and excited by causes which are not exciting and irritating to people in a normal state of health. The condition may arise from a general exhaustion of the nervous system or from undue excitation of sensory nerves, such as results from decaying teeth, misfitting shoes, or infected sores. Much of the nervousness among students comes from eyestrain and increases in the degree to which the visual organs are overworked. Lack of sleep, continued overwork, emotional waste, and the use of drugs cause nervousness through the general exhaustion which they induce. The remedy is of course to seek out and remove the causes. As a rule, when the nerve leaks are all stopped the problem of nervousness has been solved.

**To Relieve Insomnia.** — Add to the causes of nervousness a disturbed circulation of the blood and we have all the conditions for inducing sleeplessness. After closing up the nerve leaks and removing the causes of mental excitation, physical exercise is the most important natural means for relieving insomnia. A certain degree of *physical weariness is the price which everyone must pay for sound sleep*, and the attempt to sleep without this condition is somewhat akin to trying to enjoy one's meals without appetite. Exercise acts in several ways to prevent the tendency to insomnia, but chiefly through its effect upon the circulation.

**To Equalize the Circulation.** — An excess of blood in the region of the head and a diminished amount in the feet and legs is a source of general irritation, causing unpleasant sensations in the lower limbs, and inducing nervousness and insomnia. The chief causes for this condition are too much indoor life, lack of exercise, strain of the eyes, and close application to mental work. The simple remedy is to remove the causes of sensory irritation, diminish brain work, and increase the amount of outdoor physical exercise, especially walking. In persistent cases it is well to practice the head-lifting exercises elsewhere described (page 66) and to sleep with the head higher than the rest of the body. Massage of the feet and legs and the hot foot-bath are also recommended.

**To Overcome Drug-Using Habits.** — The task of overcoming the habit of using alcoholic beverages or tobacco, or even tea and coffee, if such exist, should by all means be undertaken. Even if no bad effects upon the health are noticeable, one needs to develop independence in the use of these substances, and an ability fully to control their consumption. Then it frequently happens that as the desire for the drug disappears, improvements in the health result which were not supposed to be related to its use. The young person will have little trouble in overcoming the use of tea, coffee, tobacco, or alcohol, if he resolutely makes up his mind to stop (page 159). And then the exercise of will power in this matter means the development of *a power of control* which has a broad application in all the affairs of life.

**On the Hygienic Use of the Sabbath.** — Aside from the question of religion, the Sabbath is an institution even more essential to our present civilization than to the times in which it originated. *The modern need is in the excessive demands made upon the human nervous system.* Through a proper observance of the Sabbath, the losses of the week can usually be made up and the nervous system restored to a normal condition. To obtain the needed rest of mind and the emotional nature, the Sabbath should be devoid of excitement and the usual week day irritations. The day for most people should not be given to *much* reading. Reading stimulates the brain and strains the eyes, and brain excitation and eyestrain are conditions from which a large percentage of people need to escape.

## CHAPTER XIII

## THE HYGIENE OF THE EYE IN ITS RELATION TO THE HYGIENE OF THE NERVOUS SYSTEM

"Eyestrain is the most widely prevalent and most serious of modern nerve leaks."

Good vision has always been an essential factor in bodily control, and in the evolution of the race eyes have played a most important part. Modern life, however, has so shifted the work of vision that the main question no longer is, "How well can we see?" but "How can the eyes be made to perform all the work devolving upon them without strain upon their delicate parts or injury to the nervous system?"

**The Work of Vision.** — To understand how eyestrain develops and how it must necessarily be a severe tax upon the nervous system, we must understand something of the work of vision.[1] At least four distinct processes are involved in seeing, as follows:

1. *A purely nervous process.* — This consists, first, in the stimulation by light waves of nerve cells in the retina; second, in the passage of nervous impulses from the retina to the brain; and, third, in the stimulation, by these impulses, of nerve cells in the brain. During all of our waking moments continuous streams of impulses are passing over the optic nerves and exciting activity in the cortex of the brain.

2. *An optical process, called focusing.* — This consists in the bending of light waves, as they come from the

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[1] See *Physiology and Hygiene*, pages 370–383.

objects viewed, so that they form images of these upon the retina. This is accomplished in each eye by two lenses in front of the retina — the *cornea* which forms the transparent front of the eyeball and the *crystalline lens* which lies within the eyeball just back of the pupil — and the fluids of the eyeball (Fig. 54). If light is not properly focused upon the retina, objects appear blurred and indistinct.

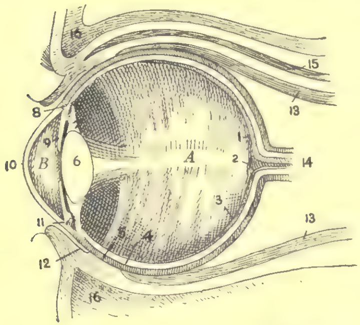

FIG. 54. — **A Sectional View of Eyeball in Position.** 1. Yellow spot. 2. Blind spot. 3. Retina. 4. Choroid coat. 5. Sclerotic coat. 6. Crystalline lens. 7. Suspensory ligament. 8. Ciliary processes and ciliary muscle. 9. The iris. 10. Cornea. 11. Lymph duct. 12. Conjunctiva. 13. Inferior and superior recti muscles. 14. Optic nerve. 15. Elevator muscle of eyelid. 16. Bone.

*A*. Posterior chamber containing the vitreous humor.

*B*. Anterior chamber containing the aqueous humor.

3. *A physical process, called accommodation.* — This consists in changing the focusing power of the eyeballs in order to adjust them to distance. Since we are continually looking from one object to another located at a different distance, such adjustments have constantly to be made. The chief instrument of accommodation is the crystalline lens. By the contraction of a small muscle surrounding the lens, called the *ciliary muscle* (*A*, Fig. 56), this is made to change its convexity and consequently its focusing power. Because of its action in changing the lens, the ciliary muscle is referred to as the muscle of accommodation.

4. *A process partly physical and partly nervous, called fusion.* — Fusion is that adjustment of the eyeballs to

each other which enables them to act as a single organ of vision. Each eyeball forms an image of the object viewed. To keep the two images from causing double vision, and to prevent the confusion which would result therefrom, the eyeballs are so directed upon the object viewed that the images fall upon corresponding places upon the retinas. The impulses from these places reach and stimulate the same cells in the brain, the result being to get a single impression of the object viewed. The instruments of fusion are six muscles attached to the outside of each eyeball (*B*, Fig. 56). These turn the eyeballs up, down, in, and out, in addition to rotating them when such movements are necessary.

**Nerve Supply to the Eyes.** — That the nervous energy expended in the work of vision is considerable, even when carried on under normal conditions, is indicated by the nervous connections of the eyeballs and their muscles. The nerves of sight (the *optic*) are the largest nerves in the body in proportion to their distribution, each one containing something like 500,000 fibers. The ciliary muscle inside the eyeballs and the fusion muscles attached to the outside of the eyeballs, though small, are strongly equipped, being supplied by the third, fourth, and sixth pairs of cranial nerves. The conjunctiva, a sensitive membrane lining the eyelids and covering the front of the eyeball, is abundantly supplied with fibers from a branch of the fifth pair of the cranial nerves. No other organ of the body approaches the eye in the abundance and variety of its nerve supply.

**Eye Defects.**—In addition to the nervous work demanded of the eyes under normal conditions, they frequently have defects which vastly increase their nervous expenditures. The more common of these defects are as follows:

1. *Hyperopia, or long sight.* — This is a defect in which the eyeball is too short for its focusing power (*C* in Fig. 55). With the eyes at rest, i. e., with the ciliary muscles in a state of relaxation, the light is not yet focused when it reaches the retina, and as a consequence objects appear more or less blurred and indistinct. One having this defect can usually see distant objects better than near ones, a fact which accounts for the term *long sight.*

Two distinct varieties of hyperopia are recognized by medical writers — the manifest and the latent. *Manifest hyperopia* is the variety which can be readily detected by looking at distant objects through convex lenses; it is represented by the strongest convex lens with which one sees distant objects most distinctly, or as distinctly as with the unaided eye. *Latent hyperopia* is the variety which is constantly concealed by accommodative effort and is only discovered by placing drugs in the eye that temporarily paralyze the ciliary muscle. Manifest hyperopia which can be overcome by an extra effort of the accommodation is said to be *facultative;* that which cannot be so overcome, as when the hyperopic person fails to see near objects distinctly, *absolute.* The manifest hyperopia plus the latent is referred to as the *total hyperopia.*

2. *Myopia, or near sight.* — This is a defect in which the eyeball is too long for its focusing power (*B* in Fig. 55). Light from distant objects is focused before reaching the retina, and hence as it falls upon the retina, causes the objects to appear blurred and indistinct. Light from near objects, however, being more divergent and requiring greater focusing power for its convergence, is focused upon the retina, thereby enabling the near objects to be seen distinctly. This accounts for the name, *near sight.*

Myopia is of two kinds, known as permanent myopia and pseudo-myopia. *Pseudo*, or false, *-myopia* is a temporary condition resulting from strain, being the direct effect of a cramp or spasm of the ciliary muscles, which overdoes the work of accommodation. It disappears when the ciliary muscles relax through rest or from the effects of properly fitted glasses. *Permanent myopia* is the result of elongation of the eyeball. It is not the immediate result of eyestrain and does not disappear when the strain is relieved. Permanent myopia, however, usually begins with the pseudo variety and owes its existence to the fact that this is not recognized and corrected.

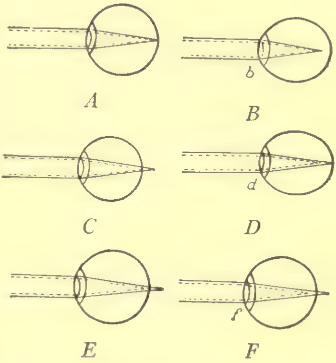

FIG. 55. — **Different Shapes of Eyeballs** and their effects upon focusing. *A*. The normal eyeball. *B*. The elongated, or myopic, eyeball. *C*. The short, or hyperopic, eyeball. *D*. Defective cornea combined with elongated eyeball to cause myopic astigmatism. *E*. Defective cornea with short eyeball causing hyperopic astigmatism. *F*. Highly defective cornea causing mixed astigmatism.

3. *Astigmatism*. — Astigmatism is a defect of the lens front of the eyeball, or cornea, which causes unequal converging power through its different meridians (*D*, *E*, *F* in Fig. 55). For a given distance it focuses light properly through one meridian, but fails to focus it properly through other meridians. The astigmatic cornea lacks uniformity of curvature, an effect which has in most cases resulted from pressure upon the eyeballs from the external muscles. Astigmatism may be either transient or permanent. *Transient astigmatism* is directly dependent upon eyestrain and disappears when this is relieved. *Permanent astigmatism*, though in most instances dependent upon eyestrain remotely, does not disappear when the strain is relieved.

4. *Muscle imbalance.* — Imbalance is a condition in which the external muscles fail to pull upon the eyeballs in a normal manner. This leads to much difficulty in the coördination, or working together, of the eyes. Cross-eyes and wall-eyes are exaggerated and easily recognized forms of this defect. In most cases of imbalance, however, the work of fusion is still possible, but is accomplished by extra work on the part of the external muscles. Muscle imbalance may be present at birth (congenital); but more frequently develops from strain and is a result of overwork of the eyes or of uncorrected hyperopia (page 268). If it be the immediate result of eyestrain, it usually disappears when the strain is relieved.

**Eyestrain.** — Eyestrain may be defined as a disturbed and oversensitive condition of the eyes due primarily to overwork of the eye muscles. It is entirely distinct from the defects just described, though it is much more likely to occur when such defects are present, a result due to the increased effort necessary for vision. It sometimes occurs in eyes entirely normal simply from improper use. Depending upon the muscles (Fig. 56) that are overworked, eyestrain is of two kinds — ciliary strain and fusion strain.

**Ciliary Strain.** — This is an overworked condition of the muscles (the ciliary) whose work is to manipulate the crystalline lens in the process of accommodation. It is more likely to occur in hyperopic and astigmatic eyes, on account of the extra work which their defects make necessary, and is absent, for a corresponding reason, in cases of simple myopia. The liability of ciliary strain is greatly increased by protracted work at close range, this having the effect of keeping the ciliaries in a constant state of contraction.

**Fusion Strain.** — This is an overworked condition of the external eye muscles. It is usually present in most cases of slight imbalance, though usually absent from eyes in which the imbalance is so great that no attempt at fusion is made. If there be a tendency for the eyes to turn out (called *exophoria*), close work greatly increases the strain, but if the eyes tend to turn in (called *esophoria*), close work may be less trying than distant work. Fusion strain is liable to develop in cases of myopia, on account of the extreme convergence of the eyes from viewing objects so very near, and in all cases in which there must be a continual readjustment of the eyeballs, such as occurs in reading on moving trains and in viewing moving pictures. The strain which results from a day of shopping or of sight-seeing is usually fusion strain. The strain which results from overwork of the eyes at close range when there are no focusing defects, or when the defects are properly corrected with glasses, is in most cases fusion strain.

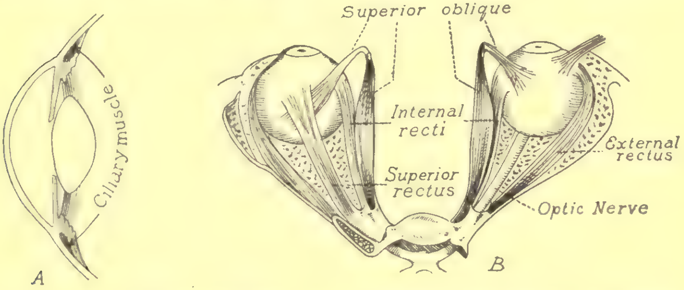

FIG. 56. — **The Muscles of Accommodation and of Fusion.** *A*. The muscle which is overworked in ciliary strain. *B*. The muscles that become exhausted in fusion strain.

**Indications of Eyestrain.** — Indications that the eye muscles are being overworked, or strained, are of two kinds — local indications which are observed upon the eyes themselves and indications that result from irritation and exhaustion of the nervous system. The local irritations include pain and fatigue in the use of the eyes upon near work, redness of the eyeballs and lids (due to the increased circulation of blood in these parts), a feeling of hardness and soreness of the eyeballs when pressed upon with the fingers, itching, smarting, or burning sensations from the use of the eyes, and increased sensitiveness of the eyes to light.

The occurrence of certain eye diseases also suggests the presence of eyestrain. Simple inflammations of the eyelids (called *conjunctivitis*), a diseased condition of the lid margins (*blepharitis marginalis*), the common stye (*hordeolum*), and granulated eyelids (*trachoma* [1]), may all result in part from eyestrain. Though granulated eyelids, styes, and certain inflammations of the eyes are directly induced by germs, conditions favorable to germ attacks are developed through strain. Even such diseases as *glaucoma* (closing of the ducts that drain the inside of the eyeballs) and *cataract* (opacity of the crystalline lens) may have some remote relation to eyestrain.

**Eyestrain and the Nervous System.** — Because of the tendency of eyestrain to irritate and exhaust the nervous system, all kinds of nervous disturbances and weak bodily conditions dependent upon nervous disturbances[1] are suggestive of this ailment. Eyestrain may be suspected whenever any of the following disorders are present:

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[1] Trachoma, or granulated eyelids, is the most widely prevalent of all the infectious diseases of the eyes of a serious nature. It is attended with much suffering and in some instances results in blindness. It is highly contagious, the germs being transferred from diseased eyes to those that are well by articles brought in contact with the face. Perhaps the most common mode of transfer is in the use of the same towel by different persons, as occurs in cheap lodging houses and also in many well-to-do private homes. Children having trachoma should be excluded from the schools for the time being.

1. *Headache.* — Most headaches (75 per cent according to some authorities) result from eyestrain. The orbital, or brow, headache is thought to be nothing more than pain resulting from cramp of the ciliary muscles. Headache in the temples, and at the base of the skull, and also sick headache are quite frequently the result of eyestrain. Though headaches arise from other causes, the prolific one of eyestrain should not be overlooked in seeking relief.

2. *Neurasthenia, or nervous exhaustion.* — If this condition results from reading or other close work, from excessive light or glare from electric lamps, or from the performance of work in which the eyes have to guide the hands through difficult or rapid movements, it is in most cases the result of strain upon the eyes.

3. *Insomnia.* — Many cases of insomnia are due to eyestrain, though in some instances the strain causes one to take more than the usual amount of sleep, this being necessary to repair the greater nervous loss.

4. *Neuralgia.* — Though facial neuralgia more frequently results from irritations from the teeth, it is in some instances caused by strain of the eyes. If the attack is in the region of the forehead or the brows, eyestrain is probably the cause.

5. *Emotional disturbances.* — Peevishness, melancholia, the tendency to worry, impatience, and disagreeable and disturbed mental states generally, very frequently

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[1] In some instances eyestrain is present without any of the local symptoms, its presence being indicated altogether by its effects upon the nervous system.

result from nervous exhaustion which has eyestrain as its primary cause.

6. *Chorea, or St. Vitus's dance.* — This disease, which is characterized by reflex periodic contractions of the muscles (either single muscles or muscle groups) and which is more frequent among children than among adults, is in numerous instances the result of eyestrain, the condition disappearing when the strain is relieved.

7. *Epilepsy and insanity.* — Eyestrain has been shown by Stevens[1] to be a contributing factor, and sometimes a chief cause, in the production of epilepsy, and certain forms of insanity have been cured through the work of the oculist.

Although eyestrain is but one of the many causes of nervous disorders, is it frequently a most important cause — one which may be compared to the heavy burden already present that enables the "straw to break the camel's back."

✓ **Eyestrain and Bodily Disorders.** — Because of its drain upon the nervous system, eyestrain may act as a contributing factor in the causation of all kinds of bodily disorders. Numerous indeed are the cases of functional disorders of the heart, stomach, kidneys, and other vital organs resulting from nervous exhaustion which has in turn resulted from eyestrain. In the same way, eyestrain may be in part responsible for diseases due to attacks of germs. Naturally as the vital processes become enfeebled, whether this condition results from nervous exhaustion or from other causes, the resistance of the body to attacks of germs becomes low (page 334).

**Necessity for Relief.** — The necessity for finding relief from eyestrain has already been suggested. There is, in the first place, the need for increasing the working capacity of the organs of vision, and in the second place, the necessity for ridding oneself of this enemy of the nervous system. Through the influence of the nervous system upon the general health, there is also the possibility of better fortifying the body against disease. Everything considered, relief from eyestrain means a long step toward the solution of the general problem of health control.

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[1] Stevens, *Functional Diseases of the Nervous System.*

**General Method of Relief.** — Eyestrain is relieved and prevented by removing or counteracting the causes which are responsible for it. These are found in part in the habits of people and in part in the condition of the eyes themselves. People working out of doors and using the eyes but little for near work are not as a rule victims of eyestrain. It is mainly the indoor worker who suffers in this way, and he usually brings the trouble upon himself through *the overuse of his eyes at short range.* The term, overuse, however, is relative and what may be overuse for one may be insufficient exercise for another. The difference lies chiefly in the presence or absence of eye defects, as already stated. If serious defects are present, overuse becomes exceedingly easy.

All methods of preventing and relieving eyestrain have reference either to lessening the work devolving upon the visual organs or to the improvement of bodily conditions that may affect the eyes. The work of vision is diminished by cutting down the amount of reading, by reducing the hours of work, by omitting night work altogether, by giving attention to the position assumed in the use of the eyes, by exercising care as to the kind of light and the degree of its intensity, and by the use of properly fitted glasses. The bodily condition which has most to do with the normal working of the eyes is general good health.

**Relief through Health Improvement.** — The effects of eyestrain always become more pronounced as one declines in health. Since poor health lessens the production of nervous energy, the leak through the eyes must at this time draw to a greater extent upon the reserve supply. Health improvement, on the other hand, causes more nervous energy to be generated, so that more can be expended in the work of vision without interfering with the vital processes. A standard remedy for eyestrain, therefore, is to improve the general health. Even when other methods of relief are being employed, conditions for increasing the bodily tone and vigor should be regularly supplied. Exercise, correct posture,[1] outdoor life, sufficient sleep, avoidance of constipation, and a suitable diet, all have the indirect effect of improving conditions pertaining to vision. If eyestrain is the result simply of overwork, the visual defects being slight, health improvement alone provides a sufficient remedy.

**Why Glasses may be Necessary.** — The reason why avoidance of excessive eye work and attention to hygienic conditions does not prevent and relieve all cases of eyestrain is found in the general prevalence of visual defects. On account of these, only a small amount of work may develop a strained condition. By counteracting the defects,[2] glasses enable the eyes to work to better advantage (Fig. 57), thereby keeping down strain and saving nervous energy. Properly fitted glasses also increase the working capacity of the eyes and prevent further development of existing defects. On account of the last-named result it is desirable that one avail himself of glasses as soon as the need for them exists.

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[1] A drooping position of the head, by interfering with the circulation of the eyes, is frequently a factor in the production of eyestrain.

[2] Corrections with glasses include the use of convex spherical lenses for eyes that are hyperopic, concave spherical lenses for those that are myopic, concave and convex cylindrical lenses for astigmatism, and prisms to some extent for the counteraction of imbalance.

**The Lens as an Instrument of Adaptation.** — Some people who know that they should wear glasses, decline to do so on the grounds that they are "unnatural," "inconvenient," or "mar the appearance."[1] Those taking this attitude fail to realize the purpose which properly fitted lenses serve. Generally speaking, glasses enable the outdoor, long-range eyes which nature supplies, or perversions of these, to be used at short range and with economy of effort. Hence in their use many people find the means of better adapting themselves to the conditions under which they live and work. Nor is this essentially different from other adaptations that are constantly made. By clothing, artificial heat, cooked food, and numerous inventions, man has adapted himself to conditions far removed from his natural environment, and by so doing, has gained a larger control over all that pertains to his physical well-being. The exigencies of

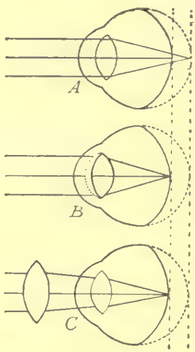

FIG. 57. — **How the Properly Fitted Lens Saves Work of Eye Muscles.** *A*. Hyperopic eyeball with accommodation at rest. *B*. The same with lens focusing for distance. The increased thickness is brought about by contraction of the ciliary muscle. *C*. The same result obtained as in *B*, through the use of a convex lens, thereby avoiding ciliary effort.

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[1] Glasses which relieve eyestrain and conserve the nervous energy not only do not mar the appearance, but are an important means of improving it. This effect is due in part to the relief of a strained expression about the eyes and in part to improvement of the general health.

modern life make a visual adaptation also necessary, and the chief means through which this is accomplished is properly fitted lenses. On this account the wearing of glasses by those who need them is just as natural as the wearing of shoes, and as far as health and efficiency are concerned, is just as important.

**Why Glasses Sometimes Fail to Give Relief.** — The most discouraging feature in the use of glasses is the fact that many people seeking their aid derive only partial relief — a few no relief at all. The causes of failure are not difficult to find. In the first place, most people put off the wearing of glasses as long as possible. Many who would have been benefited by their use in childhood do not put them on until late in life, and during all the years of strain, the defects have become highly complicated. Instead of a simple fitting for hyperopia when the trouble began (page 268), accurately ground glasses for astigmatism, myopia, or muscle imbalance are required. In such cases complete relief is difficult to obtain, especially if one must continue the use of his eyes upon close work.

A second difficulty is that sufficient time and study are usually not given by eye specialists to the cases of eyestrain of long standing. Too frequently are the eyes "fitted" at a single test or examination. In most cases it is impossible to prescribe satisfactory glasses by such quick work, and for the reason that the strained eye conceals its defects by abnormal contractions of the eye muscles. Even after glasses have been carefully fitted, the eyes should be occasionally tested to see that, in the readjustment of eyeballs and eye muscles, due to the glasses, a new fitting may not be necessary.

**Sight versus Strain.** — A fact that many sufferers from eyestrain need to learn is that most glasses are worn for the purpose of making the work of vision easier, thereby relieving the nervous system, and not for enabling the wearer to see distant objects more distinctly.[1] The presence of good sight does not mean the absence of strain, and the fact that one can see well does not remove the possibility of his eyes working uncomfortably and wastefully. Hence if difficulty is experienced in the use of the eyes, or if eye work brings on disagreeable nervous symptoms, the eye specialist should be consulted whether the vision be good or poor.[2]

**Misfits from Carelessness.** — The sufferer from eyestrain not only needs the assistance of experts in the measurement of his refractive errors and in the ordering of glasses, but he must have the conscientious and painstaking care of all who minister to his relief. Frequent mistakes are made in the filling of prescriptions and every pair of glasses should be thoroughly tested by the specialist who ordered it, before being turned over to the patient. It is not only necessary to have the correct lenses, but the frame or the nose piece which holds the lenses in place must be properly fitted to the face. If correctly ground lenses are improperly centered they may still be glaring misfits, and as such they develop rather than relieve strain. Much trouble arises from this simple cause. The glasses may have been improperly centered in the first place, though a frequent cause is the faulty repairing of frames after accidents. The two lenses must of course be on the same level (Fig. 58). While it is the duty of the specialist to see that these conditions are fulfilled when the glasses are ordered, it devolves upon the patient to see that the proper adjustments are maintained.

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[1] In numerous instances glasses do clear up the vision both for near and distant objects, and in fittings for old people this is a prime consideration. With middle-aged and young people, however, the purpose of glasses is in most cases to prevent eyestrain. In doing this, they may or may not improve the distant vision.

[2] Small refractive errors that permit of clear vision are even more likely to cause eyestrain than the large ones that cause indistinct and blurred vision. This is because the eyes make the necessary effort to counteract the small defects, while they are forced to accept and to cease trying to overcome the blur from the large ones.

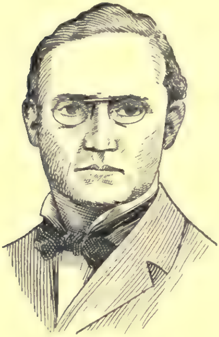

FIG. 58. — **One of Several Ways** by which properly prescribed lenses become misfits. The wearing of one lens higher than the other often develops fusion strain.

**Strain from Artificial Illumination.** — Artificial light of all kinds is more or less irritating to the eyes and much strain can be avoided by care in its use. Direct glare from lamps should not be permitted to reach the eyes as so frequently happens from the improper lighting of public halls and meeting places. If one, in facing the speaker, must look directly into a light (Fig. 59), or must receive the direct glare from the side, the effect is especially trying. If the eyes are at all sensitive, he can scarcely subject himself to such conditions without strain. The improvements that are now becoming quite general in the illumination of public halls, theaters, and churches should be still further encouraged. Indirect and semi-indirect illumination (Fig. 60, page 268), by which the glare is almost entirely avoided, is conducive both to health and comfort and is especially desirable in the home.

**Interior Decorations and the Eyes.** — Surroundings that are restful to the nervous system (page 245) are largely so from effects which they have, through the reflection of light, upon the eyes. Since the wall coverings and every object in a room reflect light, these should be selected with some reference to the nature of the light which they throw off. In deciding upon interior decorations the following points should be kept in mind:

1. *Color.* — Nature's colors — the blues, greens, and browns — are restful to the eyes, while the reds, yellows, and purples are more or less irritating.

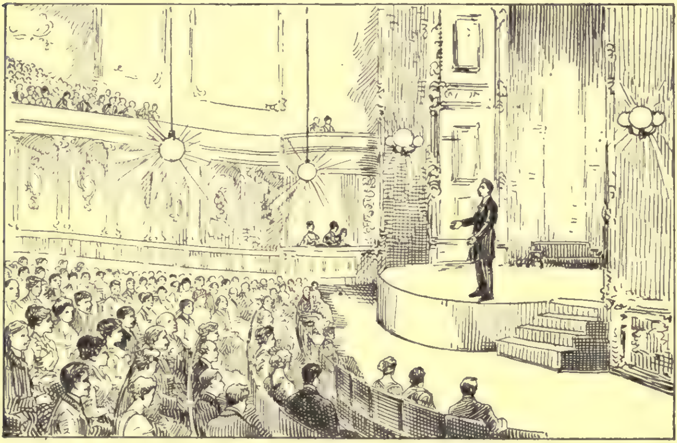

FIG. 59. — **A Preventable Cause of Eyestrain.** Many otherwise comfortable auditoriums are spoiled through faulty illumination. Only the strongest eyes can take the direct glare without injury.

2. *Surface.* — Smooth, polished surfaces reflect light without breaking it up, as does a mirror, while the dull, rough surfaces break up and soften the light, causing it to be more restful.

3. *Quantity of light entering the room.* — Since lighter shades of color reflect more light and darker ones less, the first are to be preferred in wall decorations for rooms receiving insufficient light from the outside and the second for rooms receiving an excess of light.

**The Eyes of Children.** — In seeking nerve rest through the eyes for himself, the adult should not forget the eyes of children. If relief from eyestrain is secured when it is first needed, the problem not only of the eyes but of nervous health becomes decidedly easier. Eyestrain is likely to develop very early in life. A careful study of the eyes of school children shows that fully half of the little brain workers would fare better with properly fitted glasses. To make them see better? In most cases, no. But to make the school work easier, to lessen strain, and to stop nerve leaks that interfere with health and growth. But most important of all, the putting on of glasses when the eyes first show definite signs of trouble obviates more serious difficulties in the future. This is indicated clearly by the method by which eye defects develop.

FIG. 60. — **Semi-Indirect Illumination.** The strong rays from the electric light are broken up and softened both by their passage through the diffusion bowl and by reflection from the ceiling.

**How Eye Defects Develop.** — The foundations for serious eye trouble are usually laid before the age of fifteen. There are two conditions which account for this generally recognized fact — the eyeballs of children are in a more or less plastic state and the eyes of nearly every child are to a considerable degree hyperopic.[1] When the child begins to use his hyperopic (long-sighted) eyes upon the close work of the school-room, he encounters difficulty in focusing, and in overcoming this difficulty the plastic eyeballs are frequently pressed out of shape, thereby developing an inequality of curvature of the cornea. This is the origin of perhaps ninety per cent of all the cases of astigmatism.

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[1] Why children are long sighted, and frequently as much so as old people, is best explained from the standpoint of evolution. The hyperopic eye is

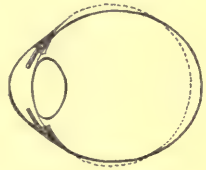

FIG. 61. — **Development of the Myopic Eyeball.** The original shape of the eyeball is shown by the dotted line. On account of strain from uncorrected defects, the eyeball has been gradually molded into its present shape. A good fitting of glasses, by relieving the strain, would have preserved the original shape.

To obtain clear vision when the eyeballs become astigmatic requires even greater effort on the part of the eye muscles. The result in this case, if the eyeballs are sufficiently plastic, is to produce a myopic elongation (Fig. 61), and this often increases to a high degree. In the production of astigmatism from hyperopia and of myopia from astigmatism, we may be sure that abnormal effort is thrown upon the external eye muscles. As a result of their increased tension, muscle imbalance is frequently developed.[1]

If relief is secured when the eye trouble begins, the

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the one which gives clearest vision for distant objects and the one which, on this account, would give its possessor the greatest advantage in the prehistoric struggle for existence. This previous racial condition is repeated in the individual.

[1] Most to be regretted of all, perhaps, are the neglected cases of pronounced muscle imbalance among children. Crossed eyes can usually be corrected with glasses up to the sixth year, but are corrected with much difficulty after that age. While the infant that has imbalance before the development of the nerve center for fusion often overcomes the defect as the center develops, imbalance which persists after infancy will not be "outgrown." Even a belated operation on the eye muscles may fail on account of the undeveloped condition (due to non-use) of the fusion center.

defects usually do not pass beyond the hyperopic stage. Simple corrections with convex lenses in most cases suffice for the time being, and when maturity is reached the defects may need no correction at all.

**A Problem of Education.** — There is no question but that school work is the chief factor in the development of eye defects of a complicated nature and of nervous exhaustion through strain upon the eye muscles. Is it necessary to pay this price for education, or is it possible to carry on the work of the school without these destructive effects?[1] The problem is beset with many difficulties, though some measure of relief is to be obtained along each of the following lines:

1. Young children should not be required to read fine print nor to do hand work of a delicate or difficult nature.

2. Children who are physically weak should not be started to school at too early an age (under eight years).

3. The school should place a premium upon physical health and vigor. The stronger the bodies of children the less plastic their eyeballs and the more vigorous their eye muscles.

4. Night work should not be required of children below the high school and only a minimum amount of those in high school.

5. Other senses than those of sight and hearing should be utilized in the work of education.[2]

6. There should be a definite system of examinations whereby the latent eye troubles of school children may be detected. For pupils whose parents are unable or

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[1] For a full discussion of eyestrain in its relation to the work of education, see Swift's *Mind in the Making*.

[2] The system of teaching children through the sense of touch, so successfully employed by the Italian educator, Marie Montessori, whatever be its other merits, has the advantage of saving the eyes.

unwilling to supply the necessary medical aid, relief should be provided gratuitously.

**Summary.** — Partly on account of eye defects, but mainly on account of protracted eye work at close range, a strained condition of the eye muscles is frequently induced. This so increases the nervous expenditures associated with the work of vision as to exhaust the nervous system and develop bodily disorders both mild and serious. *Health control is for a large number impossible without a knowledge of how to avoid eyestrain and a willingness to put this knowledge into practice.* The solution of the problem is found in the avoidance of overwork of the eyes, in the improvement of the general health, and in the use, in many cases, of properly fitted lenses.

Expert attention is absolutely essential in complicated cases of eyestrain and in many instances the eyes must be studied through long periods of time and frequent changes of lenses made before relief is finally obtained. Parents and teachers must not overlook the great liability to eyestrain on the part of children. Eye help should come at the time when it will do most good, and this is in early life when the serious defects of the eyes are developing.

**Exercises.** — 1. Describe the different processes necessary to vision and show how these make a large draft upon the nervous system.

2. Name and describe the different kinds of eye defects. Which one of these is usually present in childhood? How do the others develop from this one?

3. Define eyestrain. Distinguish between ciliary strain and fusion strain. Enumerate the conditions under which each is liable to develop.

4. What conditions in and about the eyes are indicative of eyestrain? What nervous disorders result from the strain of the eyes?

5. Why are the eyes of some much more easily strained than the eyes of others?

6. How may eyestrain cause functional disturbances of the vital organs? How may it be a contributing factor in diseases caused by germs?

7. State the general method of relieving eyestrain. Give special directions for applying this method.

8. How does health improvement benefit the eyes? What are the advantages of glasses over rest in relieving eyestrain?

9. How do properly fitted glasses adapt one to the conditions of modern life?

10. Why do glasses frequently fail to give relief? What is a possible remedy?

11. In what different ways may misfits in glasses result from carelessness?

12. Why is clearness of vision no proof of the absence of eyestrain?

13. Why should the eye troubles of children receive prompt attention? How may the wearing of glasses by children make their use unnecessary in adult life? Why does this result not always follow?

14. What may the school do toward the conservation of vision and of the nervous energy lost through vision?

## Health Work

In determining the amount and kind of work that can be safely placed upon the eyes and in finding solutions for the problems of nervous hygiene, a knowledge of the condition of the visual apparatus is necessary. Such knowledge is obtained by a study of nervous conditions in their relations to the eyes, by the effect of close work upon the eyes and the nervous system, and by testing the vision.

**Physiological Indications of Eyestrain.** — In deciding whether one is a victim of eyestrain, we must depend very largely upon the condition of the eyes and the results attending their use. Answers should be sought to the following questions:

1. Do the eyes hurt from close work, such as reading?

2. Are there frequent headaches? Do these follow reading, study, or a day of sight-seeing or shopping?

3. Is there nervousness or insomnia, and have these conditions any relation to the use of the eyes?

4. Is there inflammation of the eyeballs, eyelids, or lid margins?

5. Are there occasional styes or do small scales form at the roots of the lashes?

6. Are the eyeballs hard to the touch and is pain felt from slight pressure? (Under normal conditions the eyeballs yield slightly when pressure is applied with the fingers and are rather springy, but are not sensitive.)

7. Are the eyes irritated by bright light?

8. Is there a tendency to wrinkle the brows or to manifest unnatural facial expressions from the use of the eyes?

9. Does the one under observation drop the eyes or look to one side while conversing at close range with another?

The presence of only two or three of the conditions suggested by the above question strongly indicates the presence of eyestrain.

**To Test the Acuteness of Vision.** — In testing the power of the eyes to determine the shape, size, and outline of objects, use is made of standard test charts (Fig. 62) upon which are printed rows of letters of sizes such as can be read by the normal eye at specified distances.[1] If one standing at a given distance from the chart is able to read correctly the line which is to be read at that distance, and none of the smaller lines, his vision is said to be normal. In the school-room tests the pupil is placed at a measured distance, preferably twenty feet, from the chart, which is illuminated by light from the side or from behind the pupil. He is then asked to name the letters in the lowest line which he can conveniently read, first with one eye and then the other, keeping the unused eye open, but covered with a piece of cardboard. The results of the test are recorded in fractions in which the distance of the pupil from the chart is taken as the numerator and the distance

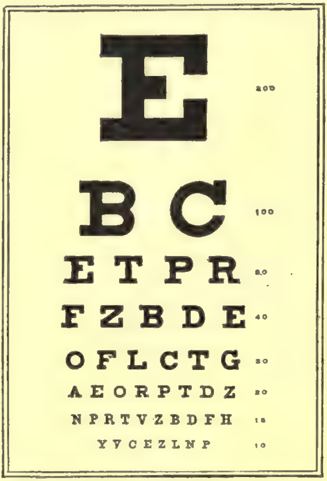

FIG. 62. — **A Reduced Representation** of a chart for testing the acuteness of vision.

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[1] Snellen's test chart is the one usually employed in schools. This may be obtained from any optical supply house, e. g., The Geneva Optical Co., Chicago. The cost is only fifteen cents.

number of the smallest line which he can read as the denominator. (The distance number of any line is the number of feet at which it is read by the normal eye, this being found upon the standard chart just above the line.) If the pupil is twenty feet from the chart and is able to read the twenty foot line, and no more, his vision is marked $\frac{20}{20}$ or normal. If he reads the fifteen foot line at twenty feet, $\frac{20}{15}$; and if he can read only the thirty foot line, $\frac{20}{30}$. Many pupils will read a given line but will miscall one or more letters. These pupils should be noted and a question mark placed after the visual fraction for each letter missed. Suppose, for example, the pupil reads the twenty foot line with the right eye and misses one letter, and with the left eye reads the thirty foot line missing two letters. His visual record is then $\begin{cases} \text{R. E. } \frac{20}{20}\ ? \\ \text{L. E. } \frac{20}{30}\ ?? \end{cases}$

**Interpretation of Results.** — The results from the tests with the chart should be interpreted in the light of the physiological indications. Taken alone, they are wholly unreliable in determining the presence or absence of eystrain, although the findings may indicate the presence of defects which cause strain.

1. $\frac{20}{20}$ and $\frac{20}{15}$ when no letters are miscalled are to be considered satisfactory if the physiological indications are in all respects good.

2. $\frac{20}{20}$ and $\frac{20}{15}$ with two or more question marks are to be considered unsatisfactory unless physiological indications are exceptionally good.

3. $\frac{20}{30}$ and less may indicate myopia, a high degree of astigmatism, a high degree of hyperopia, or a lack of sensitiveness of the retina, and are to be considered unsatisfactory even if the physiological indications are good.

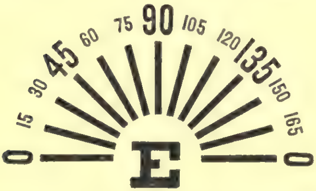

FIG. 63. — **A Half-Dial Device** used in testing for astigmatism.

**To Test for Astigmatism.** — The missing of one or more letters in the test for the acuteness of vision usually indicates astigmatism. A special test for this defect is made by having the pupil look at a dial, or half-dial, shaped chart (Fig. 63), keeping open, but covered with a piece of cardboard, the eye which is not being tested. If the lines all appear to be the *same blackness*, astigmatism is apparently not present, but if one line or a group of lines stands out more prominently than the others, astigmatism is present.

**To Test for Imbalance.** — The pupil is placed twenty feet from a small lamp in a slightly darkened room and a small glass rod (a stirring rod from the chemical laboratory) mounted over a slit $\frac{1}{8}$ inch wide in a small cardboard circle is held sidewise before and close to *one* eye (Fig. 64), while the other eye is open and has its view unobstructed. The rod gives the light the appearance of a bright streak, wholly different in appearance from the light as viewed by the other eye, and as a consequence no attempt is made to fuse the two images. To test for horizontal imbalance, the rod is shifted before the eye until a vertical streak is obtained. If the light as seen by the other eye appears in the streak, no horizontal imbalance is present, but if it falls to one side of the streak, or is out of line with it above or below, horizontal imbalance exists to the degree that the light and streak are out of line. To test for vertical imbalance, the rod is held in a vertical position in front of the eye and shifted until the streak is horizontal. If the light now appears either above or below the streak instead of in or on a line with the streak, vertical imbalance is present. (In all tests for imbalance the head must be held in a perfectly upright position.)

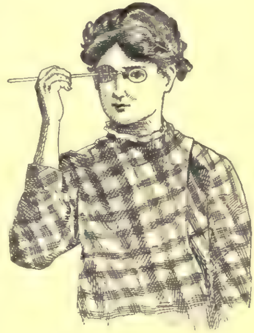

FIG. 64. — **A Simple Test** for muscle imbalance.

**Indications of Latent Defects.** — In many instances the physiological indications point conclusively to the existence of eyestrain, while the foregoing tests fail to reveal the presence of eye defects. It is quite probable in such cases that defects are present, but are concealed through involuntary contractions of the eye muscles. Such cases should be referred to the eye specialist along with those in which the defects are revealed by the simple tests.

**To Prevent and Relieve Eyestrain.** — While the one fundamental condition to be observed is the avoidance of greater visual effort than the delicate eye mechanism can normally perform, there are many things bearing upon this condition. The more important of these are covered by the following rules:

1. Keep up the general health. This increases the capacity of the eyes for work.

2. Maintain correct posture in sitting and standing, giving especial attention to the position of the head and neck (page 80).

3. Avoid, as much as possible, the use of the eyes upon close work by artificial light. If necessary to work by electric light,

see that it is broken up by a frosted globe and by properly placed shades and reflecting surfaces. Avoid the practice of late reading or study (page 242).

4. Never work or study facing the light, but arrange for the light to fall upon the work from the side or from behind. The ideal plan is for the light to come from over the left shoulder.

5. Avoid night meetings in public halls so lighted that as one faces the speaker, the light shines directly into the eyes (Fig. 59).

6. Avoid an excess of reading and, if a student, form the habit of thinking independently of books.

7. Avoid reading while on moving vehicles and trains or while lying down. If eyes are weak avoid moving picture shows.

8. Avoid the use of the eyes for long intervals upon close work, but frequently lift the eyes from the work to look off. This has the effect of relaxing and resting both the ciliary and fusion muscles.

9. When the eyes ache or smart from close work, stop using them until thoroughly rested. If the pain is intense, wring a cloth out of cold water, place it upon the eyes and lie down.

10. If unable to prevent and relieve strain by these methods, one should not delay in having the eyes carefully tested and fitted with glasses. For this work he should select the most competent eye specialist available.[1]

**Eye Lotions.** — A solution of common salt in water is a valuable wash for weak eyes. It should be strong enough to make the eyes smart, a teaspoonful of salt in a tumbler of water being the proper strength for most people. This reduces slight lid irritations, and by osmotic action tends to relieve the hardness and tension of the eyeballs which usually accompany strain. While the solution may be dropped into the eyes with the thoroughly cleaned fingers, it is best applied with an eye cup (Fig. 65). One application a day is usually sufficient, while more than two applications is likely to do harm.

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[1] While it has been customary to recommend only the oculist (a physician who has specialized in eye diseases and the correction of refractive errors) for the fitting of glasses, a class of non-medical refractionists, known as optometrists, is developing a commendable efficiency in this work. A majority of the states have passed laws regulating the practice of optometry and schools teaching the methods of non-medical refraction are found in many of our large cities. Two of our leading universities — Columbia University, New York, and the University of Ohio — now offer courses in optometry. All cases in which the eyestrain is associated with any eye disease, however, should be referred to the oculist. The commercial eye-fitters and others who attempt this work without adequate preparation should be studiously avoided.

A wash frequently recommended for its soothing effects upon the lids is a solution of boracic acid in water (40 grains to 4 ounces of distilled water). This may be applied in the same manner as the salt solution. Other preparations should not be used except by medical advice. Serious inflammations of the eyelids should be referred to the oculist or to the family physician.

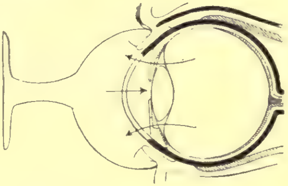

FIG. 65. — **The Eye Cup,** a device for flooding strained eyes with some soothing or cleansing solution. Strong solutions should not be used except under the advice of the physician.

**To Prevent and Relieve Styes.** — A stye is a tiny boil at the root of an eyelash and depends primarily upon an infection. Since eyestrain produces conditions which favor germ attacks, the relief of eyestrain through special care or by the use of glasses usually prevents these painful infections. The ichthyol preparation, described on page 321, applied to the stye in a thick layer for a few nights on retiring will greatly diminish the pain, and if the treatment is begun in time will destroy the infection without the usual development. The ointment is mild and will do no harm if it comes in direct contact with the eyeball.

**Eye Exercises.** — In many instances the eye muscles may be strengthened and the circulation to all portions of the eyes improved through a properly applied system of eye exercise. Among the exercises that have been proposed the following appear to have special merit:

1. Closing the lids tightly at short intervals, thereby exerting pressure upon the eyeballs. This has a massaging effect upon the lids and eyeballs.

2. Movements of the eyeballs from side to side and up and down to exercise the four straight muscles (Fig. 56), and rotating them to exercise the oblique muscles.

3. Holding a pencil a foot from the eyes and looking alternately at this and at some distant object. This exercises the muscles of accommodation and fusion.

4. Standing before an open window or upon an elevation, look intently at distant objects, discerning if possible the smallest details. The effect is to relax and rest the muscles of accommodation and fusion.

**To Remove Foreign Bodies from the Eyes.** — Foreign bodies embedded in the eyeball should be removed by the oculist or the physician. Small particles of dust or cinder may be removed without the aid of the physician, by exercising proper care. First let the tears, if possible, wash the offending substance to the corner of the eye, or edge of the lid, where it can be removed with a soft cloth. If it sticks to the ball or the under surface of the lid, it will be necessary to find where it is located, and then dislodge it. Begin by examining the lower lid. Pull it down sufficiently to expose the inner surface, and, if the foreign substance be there, wipe it off with the hem of a clean handkerchief. If it is not under the lower lid, it will be necessary to fold back the upper lid. "The patient is told to look down, the edge of the lid and the lashes are seized with the forefinger and thumb of the right hand and the lid is drawn at first downward and forward away from the globe; then upward and backward over the point of the thumb or forefinger of the left hand, which is held stationary on the lid, and acts as a fulcrum."[1] The foreign body is now removed in the same manner as from the lower lid. A large lens may be used to good advantage in finding the irritating substance.

**To Neutralize Strong Chemicals in the Eyes.** — Students in the laboratory frequently, through accident, get strong chemicals, as acids and bases, in the eyes. The first thing to do in such cases is quickly and thoroughly to *flood the eyes with water*. Any of the chemical which remains may then be counteracted by the proper reagent, care being taken to use a very dilute solution. To counteract an acid, use sodium bicarbonate (cooking soda), and for bases use a very dilute solution of acetic acid (vinegar). To guard against getting the counteractive agent too strong for the inflamed eye, it should first be tried on an eye that has not been injured.

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[1] Pyle, *Personal Hygiene*.

## CHAPTER XIV

## CONTROL THROUGH MIND

"Mind is the great lever of all things."— *Daniel Webster.*

HEALTH control is specifically a work of the mind. Through exercise of the mind the agencies of health are established and through mind the causes of disease are removed. The influence of the mind upon the body, however, is not limited to the work of voluntary control. Unconsciously to the individual, certain of his mental states react beneficially upon his body, while others react harmfully. These effects present a special problem in control to which we now turn.

**Mind as a Therapeutic Agent.** — Mind cure has been employed in some form since the very dawn of human intelligence. In the use of relics, fetishes, talismans, and charms for warding off disease, and in the ministrations of saintly persons who were supposed to influence some god or deity to restore the health, mind was about the only agency employed for curing the sick until within the last three or four centuries. That the cures resulting from appeals to superstition and to religious beliefs depended upon the state of mind which they induced was of course not understood. Hence with the discovery of the curative properties of drugs and with the development of surgery, such practices began to subside.

Mental healing, recognized as such, is a modern development, having attained its greatest prominence during the century just closed. "The development of hypnotism and the exposition of the laws underlying it . . . the collection and publication of cases of cures by mental means, the increase of nervous diseases which are most easily helped by suggestive therapeutics, the attempted duplication of apostolic gifts on the part of some sects, and . . . the great revival of psychical study and research have all been factors in the demand for mental medicine."[1] Out of this demand has come a more intelligent understanding of the whole subject and a greater ability to use the mind as a definite agency in the control of health.

**Emotional States and the Vital Processes.** — Any scientific explanation of the therapeutic value of mind must be based upon the assumption that the mental states affect the bodily processes. To realize that such is the case we have only to observe the body at a time when some strong emotion is being experienced. In anger, for example, the excited mental state produces a corresponding bodily condition — contraction of the muscles, disturbance of the circulation, etc. In fear also the effects are well marked but of a different character. Though such effects have long been known, it was only with the advent of modern psychology that their scientific investigation was undertaken. With instruments of precision the psychologist has measured the effects of certain emotions upon breathing, the circulation of the blood, and upon strength and efficiency generally. Says Professor Titchener: "When we are pleased the pulse is strong; when we are displeased, weak. The same holds with the breathing. If an experience is pleasant, we breathe more deeply; if unpleasant, less deeply. In joy we breathe in great breaths; in sorrow the breathing is short and weak. When we are pleased, the blood flows freely into the little blood vessels under the skin; when we are displeased, it is withdrawn into the internal organs of the body. When we are pleased we are stronger muscularly, can put out more strength than when we are displeased. Grief bows us down, crushes us, leaves us physically weaker than we were."[1] Such observations show that the body is strongly influenced by forces emanating from the mind, though the individual himself may be unconscious of the fact that such forces are being exerted.

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[1] Cutton, *Three Thousand Years of Mental Healing.*

**Mind as an Agency for Harm.** — Numerous instances are recorded in medical literature of the harmful effects of intense emotional states. Most of these relate to mental and nervous shock.[2] The hair has been known to turn gray in a few days from the effects of grief, and prominent among the culminating causes of apoplexy is some form of intense emotion. The ills resulting from mental excitement include disturbances of digestion, circulation, respiration, excretion, and bodily metabolism generally, as well as effects relating directly to the nervous system. Lorand, for example, calls attention to the development of diabetes through fright. "We have published two cases of young women who suddenly contracted diabetes after fright, while previously there had been no symptoms of such; and in a third case, glycosuria was increased considerably. This last case was one of mild diabetes; the sugar increased to a very great extent the day following the intelligence that the patient had lost his fortune in a coal mine accident."[1]

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[1] Titchener, *A Primer of Psychology.*

[2] Recent investigation has shown that the shock attending surgical operations is to a considerable extent the result of fear and anxiety on the part of the patient. In the so-called shockless operations every effort is made to relieve the patient's anxiety and to remove the other causes of nervous depletion. When such precautions are carried out the chances of recovery are greatly increased.

**Digestive Disturbances from Emotional Causes.** — While strong emotional disturbances have long been known to react harmfully upon the digestive processes, recent experimental work has placed our knowledge upon an accurate and reliable basis. Such states as horror, deep disgust, fear, worry, and anxiety have the effect of diminishing the flow of the digestive fluids and of checking peristalsis, and as Dr. Cannon points out, of producing results which react in turn to intensify the harmful mental states. "An emotional disturbance affecting the alimentary canal is capable of starting a vicious circle; the stagnant food, unprotected by abundant gastric juice, undergoes bacterial fermentation, with the formation of gases and of irritant decomposition products. These, in turn, may produce mild inflammation or be absorbed as substances disturbing to metabolism, and thus affect the mental state. And the depressed mental state that accompanies indigestion may still further prolong the indigestion."[2]

**How Harmful Effects are Brought About.** — While the relation of mind to the body processes is not fully understood, there appear to be three rather well-defined methods by which the disturbing mental states produce harmful bodily results. In the first place, they waste the nervous energy, and as suggested in Chapter XII, the energy thus wasted cannot be used for its intended purposes. In the second place, they supply extra-powerful stimuli to the vital processes which over-excite certain organs, such as the heart, and inhibit (check) the action of other organs, such as those of digestion. And in the third place, they interfere with the chemical processes of the body, causing the production of substances which are irritating and in some instances poisonous. These methods of action, as well as the harmful effects that are produced, are highly suggestive of the importance of the problem of mental hygiene.

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[1] Lorand, *Old Age Deferred.*

[2] From article by Dr. W. B. Cannon, in *American Journal of the Medical Sciences*, April, 1909. See also Cannon's *Bodily Changes in Pain, Hunger, Fear, and Rage.*

**The General Method of Control.** — Authorities quite generally agree that *agreeable and restful mental states make for good health* and that *disagreeable, over-exciting, and depressing states make for disease.*[1] This fact shows clearly the lines along which effort to use the mind as an agency for securing good health must be directed. Mental and emotional states that are agreeable or restful must be entertained; those that are disagreeable, over-exciting, or depressing must be avoided. This necessitates more or less of self-discipline whose aim is to direct the general trend of consciousness.

**Conditions for Success.** — To control the mental and emotional states is by no means an easy task; in some instances one gains such control only by bringing to bear upon the problem all the forces at his command. Conditions making for success are the following:

1. A proper mental attitude. In the first place, one must feel that self-mastery is essential and must be attained; and in the second place, he must entertain that optimistic, hopeful view which prevents discouragement

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[1] The basis for agreeable states of mind will of course vary with the individual, depending upon the general disposition, previous training, and physical condition. Hence what would be an agreeable contemplation for one might be decidedly disagreeable for another. For example, some physically and mentally strong persons delight in contests and are stimulated and pleased by them, while others are greatly disturbed by any manifestation of hostility or even friendly rivalry.

from slight failures and enables him to look over and beyond the petty annoyances of everyday life.

2. Persistency of effort. One must work patiently, systematically, and persistently to the end of securing control.

3. A regular and natural outlet for the mental energies.

4. Effort which is in harmony with the laws of mind. The mental laws that need most to be observed are the laws of habit, the laws of suggestion and auto-suggestion, and the law of exercise.

**The Law of Habit.** — Activities of the mind, like those of the body, tend to recur through force of habit, and to take place automatically. Mental states that have been frequently entertained come back apparently of themselves. We may worry from habit or from habit we may keep the mental horizon bright and clear. Control of the mental states means, in many instances, the breaking up of habits of long standing and the formation of new ones to take their places. This cannot, as a rule, occur quickly, but must be accomplished by effort extending through long periods of time. Moreover, to utilize the habit-forming tendency to best advantage, one must know definitely what states are to be entertained and what are to be excluded from the mind. To this end it is recommended that the individual practicing self-discipline prepare two lists for his guidance somewhat as follows:

*States to Avoid*

Undue disturbances from the thoughts and opinions of others.
Self-consciousness and self-pity.
Thoughts of pain and disease.
Feelings of envy, hatred, jealousy, etc.

*States to Entertain*

Feelings of courage and self-confidence.
Confidence in and good will toward others and interest in their welfare.
Indifference toward petty trials and inconveniences.

| | |
|---|---|
| Pessimistic thoughts. | Optimistic thoughts |
| An over-serious attitude toward trivial matters. | Indifference to, or only slight concern for, bodily symptoms. |
| Gloomy states of mind. | Cheerfulness. |
| Brooding over disappointments. | Hopefulness. |
| Worry. | Thoughts of work and of the public's welfare. |
| Fear. | |
| Etc. | Etc. |

With a clear-cut notion that such and such states are not to be entertained, that if they do make their appearance they are to be *inhibited*,[1] the mind is gradually trained toward the states that are permissible. The result, if the effort is kept up, is the formation of the desired habits — the automatic turning of the mind toward the thoughts and emotions that are helpful. But until the habits are established, a mental watch must be kept whose purpose is to direct the course of consciousness, keeping it from forbidden fields and turning it toward the profitable as well as the pleasant side of life.

**Suggestion and Auto-suggestion.** — In the formation of good mental habits, one will find his worst enemies and his most formidable allies (when he enlists their support) in the two exciting causes of mental action, known as suggestion and auto-suggestion. The term, *suggestion*, applies to the *automatic mental reactions* that result from the words and actions of people or from impressions made upon the mind by physical surroundings or by what one reads. *Auto-suggestion* applies to the influence which the individual has upon himself in the direction of his thoughts and the control of his emotional states. If these agencies are unappreciated, the watch which we have set upon our consciousness may be kept extremely busy without accomplishing the purpose for which it was appointed. Even the mental habits themselves may be quickly set aside through the dominating influence of suggestion and autosuggestion.

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[1] Inhibition in this case should consist in the substitution of desirable states of mind for those that are undesirable. To inhibit in the sense of preventing thought altogether is neither possible nor desirable.

**Suggestion in Everyday Life.** — The agencies for suggestion, good and bad, are on every hand, and among these, people play by far the larger rôle. All are in a way suggestionists, belonging to one or the other of two classes — those who react beneficially and those who react harmfully upon their fellows. There are individuals, for example, who in their common mode of greeting, call attention to our physical shortcomings or sickly appearance, thereby suggesting unpleasant and apprehensive states of mind; and there are those who by their cheery and encouraging salutations excite states that are pleasant and hygienic. Having access constantly to the minds of our neighbors, we should study to use this privilege for their benefit as well as our convenience. And then our own success very frequently depends upon our ability to excite desirable states in others. This fact must be kept in mind by the merchant in selling goods, the physician in curing the sick, the clergyman in uplifting humanity, and all those whose work requires coöperative effort. Children are especially susceptible to suggestion, and it is largely through this means that they receive their zest for learning and acquire their habits of thought. In the home suggestion is a most important character-forming agency, doing even more than heredity to engraft the disposition of the parent upon the child.

**Suggestive Therapeutics.** - Illustrations of the value of suggestion in the cure of disease abound on every hand.[1]

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[1] So-called cures through suggestion consist either in relieving bad states of mind (fear and imaginary sickness) or in improving conditions induced

The child injured in his play is cured by the mother's kiss. The adult neurotic, from whom drugs must be withheld, is relieved of bodily distress by bread pills or hypodermic injections of distilled water. Hundreds of invalids have been cured by visits to the tombs of noted saints or by simply gazing upon their pictures or their bones. If one becomes obsessed by an idea, suggestion is often the best way of dispelling the illusion. For example, a woman who was greatly distressed by pains which she believed to come from the presence of a live lizard in her stomach, was completely cured by a mock operation and the sight of the supposed lizard in a bottle.

If one is sick and something is done to give relief, and this meets the approval of the patient, a feeling of improvement is very likely to follow. This is why the physician often finds the patient on the highroad to recovery when he arrives and why the wrong remedy sometimes produces the desired result. The story is told of a doctor who, on being called to treat a chilly patient, ordered the attendants to surround her with hot water bottles. She was immediately relieved. The doctor, however, was amazed to discover that his order to "surround the patient with hot water bottles" had been carried out by filling a score or more of empty bottles and fruit jars with hot water and setting them on the floor around the patient's bed.

**Harmful Suggestion through Patent Medicine Advertisements.** — Realizing to what an extent suggestion is a means of calling up undesirable thoughts and states of mind, one's only defense is often to avoid the means through which the suggestions arise. Many get harmful

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by these. While a decided change of mind may influence the course of almost any disease, nervous disorders and functional diseases dependent upon nervous weakness are most easily benefited by suggestion.

suggestions through what they read, and especially has it been observed that the perusal of treatises on disease is liable to cause distressing symptoms in people who are perfectly sound. Venders of patent medicine have been quick to take advantage of this fact and, by spreading broadcast pamphlets which paint lurid pictures of the diseases which their nostrums are supposed to cure and which portray the direful consequences that arise from delay in securing and administering the proper remedies, they have found a reprehensible method of increasing their profits. They suggest imaginary diseases which, like the lizard in the stomach, require a suitable remedy — that being the particular medicine advertised.

**To Keep Harmful Suggestion in Abeyance.** — To the extent that one is able to control his physical, social, and æsthetic environment, is he able to control the agencies that influence, through suggestion, his mental states. The neighborhood in which one lives, the people with whom he associates, the books he reads, the landscapes and even the pictures upon which he allows himself to look, are all agencies for suggestion, good or bad, and to the effect of these he may well give heed. On the other hand, the individual whose mind has been properly disciplined will find his greatest protection against pernicious suggestion in his power to determine his own mental states and to select the subjects about which he thinks — in the exercise, in other words, of his power of auto-suggestion.

**Positive and Negative Auto-suggestion.** — Auto-suggestion, like suggestion, may be good or bad. If one is inclined to brood over bodily pains and symptoms, or to take a pessimistic view of his immediate circumstances or of life in general, he is continually suggesting to himself disagreeable states of mind. On the other hand, a belief in the soundness of one's body, the essential goodness of human nature, and the working out of everything for the best, is a constant source of auto-suggestion of a helpful nature. Success in controlling the mental states must ultimately depend upon the degree to which one is able to train his auto-suggestive faculty into an ally for good. Some people simply cannot, or will not, permit themselves to become unhappy, because forsooth it matters not how much there may be to suggest disagreeable states of mind, the busy auto-suggestive faculty, ever working for good, keeps the mental attitude normal in essential respects.

**Faith and Auto-suggestion.** — The foundation of auto-suggestion of a helpful nature is knowledge, but in the absence of positive knowledge, a substitute is found in faith. Faith is of the nature of *a trustful expectation* and must have some foundation either in fact or theory. A superstitious faith is better than none at all, and a charm or a sign may preserve the needed attitude of mind on the part of the savage, whereas a different groundwork is necessary for one of greater intelligence. In times of serious illness, the auto-suggestive faculty may be supported through knowledge of the power of the body to overcome disease, belief in the potency of some medicine that is being taken, or by confidence in the skill of the attending physician. If faith in the possibility of recovery is lost, the chances are greatly against the patient unless he becomes indifferent as to the outcome. If as a result of this attitude the mind assumes a restful state, conditions are favorable for recovery.

Greatest of all and most far-reaching in securing desirable auto-suggestive effects, is the very general belief in the existence of a Divine Being who is able and willing to aid those who seek his assistance. The devout religionist who believes himself to be "the child of the living God" finds in this thought a ground of faith sufficient for all the exigencies of life. This is why the most successful of the methods of mental healing have been those in which the appeal is through the religious life of the patient.

**The Law of Exercise.** — That some form of mental exercise is necessary to healthful states of mind is a fact which must not be overlooked. Almost invariably does idleness lead to some form of ennui and this is a recognized cause of disease. *The mental energies must be expended* and there is nothing better for this purpose than some employment in which one takes an interest. If this cannot be supplied in the gaining of a livelihood, the building and keeping up of a home, the rearing and the education of children, or some other of the fundamental human interests, then one must, for his own sake, seek out some line of study or employment which will utilize his mental energies. It matters little whether this be remunerative or non-remunerative, so long as it supplies an adequate outlet for his mental forces. It is in this way that a harmless hobby often serves a useful purpose.

Work, even hard work, is sometimes the only régime that clears the mind of undesirable states. For some the more difficult the task the greater the pleasure, and so long as the energies are not overtaxed the results are good. To become interested in some great problem is to forget the little irritations and vexations of life, and to lose oneself in the great stream of human progress is to find an added joy in living.

**Worry and Fear.** — Worry and fear, both on account of their effect upon the health and the extent to which they are indulged, deserve special study. These states are closely related, worry being the result often of a vague and ungrounded feeling of fear. The problem of prevention is best attacked through a general campaign for the upbuilding of health and the strengthening of the nervous system.[1] Having first closed up, as far as possible, all nerve leaks, and eliminated unhygienic conditions generally, there remains the distinct problem of self-discipline, the purpose of which is to establish proper habits of mind and to provide helpful outlets for the nervous energy.[2]

Helpful in the solution of the problem of fear are all those conditions that make for courage and self-confidence. Physical exercise, vigorous thinking, and health-giving agencies generally, by increasing courage and self-confidence, aid indirectly in casting out fear. That women suffer more keenly from groundless fears than do men is probably because they are more poorly developed physically. When the physical training of women receives the attention that it should, they will suffer vastly less from purely nervous and emotional disorders.

**Mental States of Children.** — Many of our mental habits go back to childhood. The unrestrained indulgence of harmful emotional states during the formative period undoubtedly increases life's difficulties during the periods that follow. *Children should be taught emotional control.* They should learn very early to inhibit the states of mind that are irritating to others as well as harmful to themselves. It is well also to protect children from undue excitement and to restrict their activities to the plain and simple things of life. They should be shielded from groundless fears and should be given every opportunity for physical development. That children should never be teased or irritated for the amusement of those older requires no special argument.

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[1] Those who have studied the problem of checking worry and kindred states of mind have observed that the more the nervous system is run down the greater the tendency for these to persist. This suggests that, in many instances, worrying and fretting are the result of general nervous weakness. Just as wood burns when it is heated to the kindling temperature, so is it the nature of most people to worry when the nervous energy is reduced to the worrying point. There is very general agreement with the statement of Dr. Chas. W. Eliot that "anyone who earnestly desires to cultivate a calm temperament and serenity of spirit would do well to provide himself, if possible, with strong muscles and obedient nerves."

[2] A successful teacher on being asked if she ever worried, replied, "Very seldom. When something occurs to make me worry, I do some hard thinking. This usually removes the cause of the worry." Don't worry, but think, should be the motto of everyone trying to overcome this pernicious habit.

**Limitations of Mental Therapy.** — While the fact is well established that the mind supplies a valuable agency both for the promotion of health and the cure of disease, this agency has well-defined limitations. A right attitude of mind cannot take the place of exercise, pure food, outdoor life, or any other of the fundamental hygienic conditions. Nor in the case of disease can it replace the services of the regular physician except in so far as the disease in question is one of mental origin or owes its continuance to mental interference. The broken bone must be reset by the surgeon, most diseases due to chemical causes require chemical treatment, and diseases caused by germs are best cured by methods based upon the life-habits of these organisms (page 347). While the influence of mind upon the health must not be overlooked, the mistake should not be made of attaching undue importance to its hygienic and therapeutic value.

**Summary.** — Agreeable and restful states of mind make for health; disagreeable, exciting, and depressing states make for disease. The problem is to secure the first and avoid the second. While suitable outlets for the mental energies and conditions that insure bodily vigor and nervous health are necessary to success, the actual solution of the problem is through self-discipline. *The individual must control his mental and emotional states.* To this end he should apply himself persistently, using his mental forces to the best advantage, and adapting his efforts to the laws of mind.

**Exercises.** — 1. In what different ways is mind an agency in securing health? How may it become an agency in the causation of disease?

2. Describe the effect of strong emotions, such as anger and fear, upon the vital processes.

3. By what different methods may intense emotional states injure the health?

4. State the general method of using the mental states as a means of controlling health. Upon what conditions does success depend?

5. Explain the law of habit. How is this to be applied?

6. Define suggestion. How is one to secure the good effects of suggestion and avoid those that are harmful?

7. How does the law of suggestion operate in everyday life? Illustrate.

8. How does suggestion cause disease? How may it be used as an agency in the cure of disease?

9. Distinguish between suggestion and auto-suggestion. Upon what does helpful auto-suggestion depend? Why should one not deceive himself regarding his physical condition?

10. State the value of work in gaining emotional control. How may overwork lead to the opposite result?

11. What bodily conditions lead to disturbed mental states? How are these to be avoided?

12. Enumerate conditions for the avoidance of worry.

13. In what different ways is physical vigor an aid in the avoidance of fear?

14. Why should children be taught to control their emotional states? Why should they not be teased or frightened?

15. In a system of health control how much emphasis should be placed upon mental and emotional control?

## Health Work

**Habit XII.** — *Of Mental Control.* Entertain agreeable and restful states of mind and avoid those that are disagreeable, irritating, and depressing.

The means for the establishment of this habit have been set forth in sufficient detail in the text and to this the student is referred. Of the many special problems likely to arise in controlling the mental states, the following are the most common.

**To Avoid Worry.** — In seeking to avoid worry the fact must be taken into account that the tendency is usually the result of a combination of causes. Hence effort must be made both to remove the immediate exciting cause and also those general conditions that are indirectly responsible. The following points may well be observed:

1. Keep up the general health, being careful to conserve the nervous energy. Avoid strain of the eyes.
2. Take sufficient physical exercise each day to insure sound sleep at night.
3. When an exciting cause of worry arises, search earnestly for the means of removing it.
4. Displace, if possible, the *worry-thought* with thoughts of work, of recreation, of things pertaining to study, etc.

**To Eliminate Fear.** — Fear is an intensified feeling of impending danger, and as stated in the text, is a chief cause of worry. To avoid fear after it has become an established habit is not an easy task. The whole outlook upon life may have to be changed — a new philosophy instilled or a new faith in humanity or in Divine Providence awakened. The following rules, though insufficient in themselves, are helpful in the solution of the general problem:

1. Develop the muscular system in order to avail oneself of every advantage that may come from a feeling of physical strength.
2. Conserve the energy of the nervous system.
3. Employ common sense to the extent of convincing oneself that *what is feared is usually less harmful than the constant entertainment of the feeling of fear.*
4. In the presence of any condition exciting fear, one should force himself to act as a courageous person would under such circumstances. This method is said to be employed to excellent advantage by hunters, sailors, and others who are frequently exposed to real danger.

**To Avoid Antisocial Feelings.** — Our mental and emotional states may be classed as social or antisocial according to whether they lead to harmonious relations with other people or to the reverse. It behooves all to avoid, as far as possible, the states that excite friction and strife, and to cultivate those that make for social harmony and good will. While many things bear upon this problem, our prevailing states of mind are more likely to be of a desirable nature if our own conduct is up to approved standards. We should:

1. Develop the habit of being agreeable to associates.

2. Treat all people with patience and forbearance, overlooking defects and shortcomings of a trivial nature.

3. Follow the rule of thinking pleasantly of people or not at all.

4. Avoid gossip.

5. Entertain no grudges and seek reconciliation after disagreements and misunderstandings.

6. Avoid the company of those who habitually arouse in us disagreeable states of mind.

**Adjustments After Mental Shock.** — While the avoidance of mental shock is most desirable, such avoidance is not always possible. It is a necessary part of human experience to meet at times with disappointment and to have hopes and ambitions shattered. To lose friends and relatives, to face impending danger, and to meet conditions and circumstances of a disagreeable nature is the common lot of man. The problem is to prevent the unavoidable shocks from interfering with health and efficiency and to keep them from giving a disadvantageous turn to the course of life. While the problem must vary with the individual, the following rules are worth consideration by all:

1. On meeting with reverses in fortune, do not dissipate nervous energy in bewailing the loss, but use this in renewed effort to succeed.

2. When forced to give up friends or relatives, be grateful for those that remain and develop those qualities of mind and heart that win friends and make new relationships possible.

3. Be overcome by no calamity or misfortune, but through the conservation of the forces of mind and body, repair the losses and overcome opposing obstacles.

**To Use the Mind as a Curative Agency.** — The need for entertaining proper states of mind increases as the health declines, and is greatest during periods of invalidism. The general mental trend of the invalid should be of a restful, agreeable nature. He should not permit himself to get into a perturbed state relative to his condition, and if he cannot take an optimistic view of the outcome, he should school himself to indifference. Although calls from discreet friends are at times advisable, excitement, worry, and overtaxing of all kinds should be avoided. The invalid should read little on account of the danger of eyestrain, though he may have others read to him. Everything considered, the general state of mind described by the term "vegetative" is usually the one most conducive to rapid recovery.

# CHAPTER XV

## THE PRINCIPLES OF NERVOUS CONSERVATION IN THEIR APPLICATION TO MENTAL WORK

"The force of the understanding increases with the health of the body." — *Democritus.*

"Learning or the working in of new nervous activities belongs to the foundations of a sound nervous hygiene, the preservation of the nervous force and to the elasticity of nervous action."— *Forel.*

Brain workers as a class are especially prone to violate fundamental laws of the body. By so doing they not only lose in health, but they also defeat the very purpose toward which they strive. Every brain worker should be thoroughly familiar with the conditions upon which efficient and healthful mental work directly and remotely depends.

**Fundamental Conditions.** — Fundamentally two conditions are essential to effective mental work — bodily vigor and a well-trained mind. The first condition is supplied through obedience to the laws of the body; the second is the result of an educative process which is best carried on by taking into account the laws both of the body and the mind. The attempt to train the mind without supplying the conditions for bodily vigor must result in failure. Harm also results when we attempt to carry on mental work while ignoring hygienic needs. The problem of the brain worker is to supply such a degree of bodily vigor as will enable him to work effectively from day to day and will *insure a continuance of his efficiency for the days to come.*

**Dependence of Mind upon Body.** — "A sound mind in a sound body" is a principle upon which all agree, but one which, in modern educational methods, has until quite recently been ignored. The reason why the best results from a mental standpoint cannot be obtained without a basis of good health is easily explained. In the first place, mental work requires energy, and the supply of energy depends upon the effective working of all the vital processes. Sufficient nourishment, a surplus of oxygen, a good circulation of the blood, and organs active in the elimination of waste, are as necessary to the work of the brain as to the work of the muscles. In the second place, the effect of disease, or even the lowering of bodily vigor, is to fill the blood with poisonous wastes and these interfere with the cells of the brain. In the third place, the unpleasant sensations arising from weakness and disease are a source of annoyance and of distraction, causing the nervous energy to be wasted through worry and irritation.

**Mental Interference from Physical Conditions.** — When the attempt is made to carry on mental work to the neglect of agencies fundamental to health, and this is persisted in for some time, conditions are likely to develop which seriously interfere with the work of the mind. A few of these may be briefly mentioned:

1. Disturbances of the circulation, causing an excess of blood in the region of the head and a diminished amount in the feet and legs (page 249). There may also be a rise in blood pressure, due in part to increased nervous tension and in part to accumulating waste.

2. Loss of ability to sleep soundly and thus to attain the full restoration of nerve cells through this means (page 243).

3. Strain of the eyes, and with this often a train of nervous disorders (pages 256–264).

4. Excess of irritability of the nervous system, which is highly wasteful of the nervous energy.

5. General bodily weakness, which causes physical and mental fatigue on slight provocation.

But in spite of these serious consequences, there is a very general tendency for the brain worker to neglect his bodily needs. A full understanding of the problem requires that this be explained.

**Why the Brain Worker Overlooks Bodily Needs.** — The tendency among students and other brain workers to neglect conditions essential to health rests upon several well-defined causes. Effective mental work requires close application, and the time and opportunity for attending to bodily needs are not easily found. Our automatic mechanism of control (page 36) does not provide for important health conditions, such as exercise and outdoor life, and decline in health from physical neglect comes on so gradually that the changes from day to day are not detected. But the most far-reaching cause of all, perhaps, is the general misunderstanding of the nature of mental work and its effect upon the body when pursued to the exclusion of other forms of activity.

**Muscle Work versus Brain Work.** — While the muscular system forms about 41 per cent of the entire body weight, the nervous system, including the brain, forms less than 3 per cent (Fig. 66). This fact, in itself, shows an essential difference between brain work and muscle work. Muscle work may be looked upon as the main product which the body is capable of producing, while brain or intellectual work is but a side issue, a by-product as it were, of the main work. This difference is vital when considered from the standpoint of body welfare. A vocation whose demands are chiefly upon the muscles calls into activity practically all the different varieties of cells (page 97), and by so doing, maintains healthful bodily processes. It provides, in this way, for the indefinite continuance of such work. A vocation, on the other hand, whose demands are chiefly upon the brain, promotes conditions which, if not counteracted, slowly undermine the health. Brain work carried on alone is self-limiting in time. Hence while physical work may be hygienically pursued without mental work, continued mental work is possible only by keeping up a certain amount of physical activity.

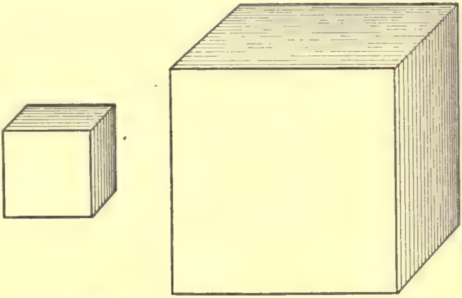

Fig. 66. — **Proportional Amounts of Body** exercised by mental and physical work. The ratio of the small cube to the large one is equal to the ratio of the brain to the muscular system.

**Body Training for Mental Work.** — To keep from reducing his powers faster than they can be restored, the brain worker should treat his body somewhat as the intelligent farmer treats his soil. He will be constantly putting back as much as he takes out. To accomplish this purpose he must give constant attention to at least five conditions:

1. *Sufficient physical exercise.* — The muscles of the brain worker should be firm to the touch, well developed, and capable of considerable exertion without undue fatigue. While there may be no direct relation between brain and brawn, it is only by supplying the exercise that keeps up muscular tone, that the brain worker can

be sure of maintaining those internal bodily conditions that insure health.[1]

2. *Correct posture.* Both on account of the close relation of correct posture to good health (Chapter V) and the constant tendency of the brain worker to assume positions that are unhygienic, much attention must be given to this problem.

3. *Sufficient outdoor life.* — Outdoor air acts upon the brain and nervous system somewhat as a tonic, but without the undesirable effects of the drugs classified under this head. In many instances the mental product can be actually increased by working in the open. Not only should the brain worker spend a considerable portion of each day out of doors, but he should also give careful attention to the ventilation of living and sleeping rooms.

4. *Thorough elimination of waste.* — If the skin, liver, lungs, and bowels of the brain worker are not sufficiently active, poisonous wastes are retained, and these interfere with the delicate workings of the brain. Of the different kinds of eliminative work, that of the bowels is most likely to be insufficient. In seeking relief the mistake should not be made of depending upon drugs but, while using mild laxatives as occasion requires, earnest and persistent effort should be made to overcome the difficulty through natural means (pages 172–182).

5. *Nervous conservation.* — The brain worker, of all people, should practice nervous conservation. On the one hand, he must give attention to all those conditions upon which depend an adequate supply of nervous energy

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[1] The amount of exercise needed by the brain worker will of course vary with the individual. From the standpoint of effort, the amount should be equivalent to the exertion necessary for a daily walk of from three to six miles; in point of time it will vary from one to three hours.

and on the other hand, he must avoid the sources of nervous waste (Chapters XII, XIII, and XIV). In addition to these general phases of the problem, the brain worker has a special problem in nervous conservation — the economical and effectual application of his mental powers.

**Education and Mental Conservation.** — That the educative process through which the mind of the brain worker must pass has much to do with his efficiency, is everywhere conceded. If one's education has consisted of learning only and not of doing, if his reasoning powers have been permitted to lie dormant while his memory was being stored with facts, he may be less able to use his mind as a causative agent than if he had never attended school or college. Mental efficiency implies ability to perceive relationships, *i. e.*, *to think*. At some time, in school or out of school, the efficient brain worker has learned to associate effects with their causes, to perceive underlying principles and conditions, and to interpret facts and phenomena according to these. When such a mind takes up a problem or embarks upon an enterprise, it realizes that success depends upon the fulfillment of certain conditions and that if these are not fulfilled failure must result. *A chief aim of the school must always be to supply opportunity for, and drill in, thinking.*

Next in importance to the educative process are the subjects of study. To store the mind with facts that have little or no relation to the life work is manifestly a waste both of time and of nervous power. On the other hand, loss is likely to result from failure to supply a sufficiently broad and varied training. The problem is not such as can be solved by a few simple rules but must be worked out according to the capacities and aims of the individual.

**Ability to Concentrate.** — A frequent source of waste on the part of the brain worker is failure to get his mind to take hold of and work upon the task which he attempts. The student, for example, is frequently unable to concentrate upon his lessons; when he would study, his mental currents persist in flowing off in other directions. Such waste is to be prevented by observing the conditions which determine the lines along which the mental forces naturally expend themselves.

As everybody knows, much may be done through voluntary effort in keeping the mind upon its task. As the undesirable thoughts would slip into the mental field, they are pushed aside, and when the desirable thoughts would escape, they are brought back. This method, however, is wasteful, being somewhat akin to the efforts of the schoolmaster to keep his pupils at work when one and all are intent upon play. Voluntary effort is necessary at times, to be sure, and is to be recommended, but is never so prolific of good results as the method which depends upon a vital interest in the subject in hand.

**Value of Interest.** — Though the field of consciousness is occupied at all times with a variety of feelings and thoughts, only one of these can have the center of the field at a given time or can hold the attention. Referring to the diagram (Fig. 67) which represents the mental field of a business man on his way to work, it will be seen that thoughts of business occupy the center of his consciousness. In the first place, this is so because the man is engaged in business and has a natural interest in making it a success, and in the second place, because he is on his way to his office and anticipates the tasks which there await him. He does not have to force himself to think of business; his mind naturally turns in that direction. Through habit this has become for him the natural outlet for his mental energy.

As the illustration suggests, the main element in the solution of the problem of mental direction is an *attracting interest.* Such an interest may be a natural condition or it may be developed through study, investigation, observation, or experimentation. Before a vital interest can be developed, however, it is frequently necessary to rid the mind of much useless material — mental rubbish, so to speak.

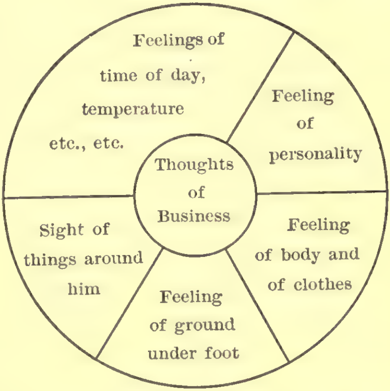

FIG. 67. — **Diagrammatic Representation** of the supposed field of consciousness of a business man on the way to his office. Being concerned about his work, thoughts of business naturally occupy the center of his field at this time. Illustrative of the value of interest in directing mental activity. — From Thorndike's *Human Nature Club* (Longmans).

**Disposition of Mental Rubbish.** — Some minds are like unkept workshops. There is so much loose rubbish lying about that it is difficult to find the tools which one wishes to use or a suitable place for using them. In such minds the effort at concentration is difficult, because there is likely to be more attraction for something of the nature of rubbish than for useful work.[1] A most practical problem, therefore, is that of cleaning out the rubbish and putting the mental workshop in order. The simple method of accomplishing this purpose is to *lose interest in the worthless material*, as may be done by developing an interest in things of vital moment. Though shifting the interest may not remove the rubbish entirely from the memory, it consigns it to such remote positions that it can no longer occupy, unbidden, the center of the mental field. This for practical purposes is all that is desired.

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[1] The author has frequently talked with students relative to their failures to concentrate upon their lessons. The trouble in practically all such instances is with the student's natural interest. This is strong for matters outside of school (athletics, social affairs, etc.), but weak for the subjects

**Concentration a Habit.** — Encouraging is the fact, now generally conceded, that the power to concentrate the mind is a habit, and like other habits is to be acquired through voluntary effort. If one who experiences difficulty in holding his mind upon its appointed tasks will persist in his efforts, doing what he can to develop an attracting interest and to rid his mental workshop of accumulated rubbish, he will observe a gradual improvement in his ability to accomplish results. This means that he is developing the habit of concentration. The development of this habit means more, perhaps, than any other single fact in the economical use of his mental powers. Its influence is apparently not limited to the working portions of the day, but pertains to the leisure periods and aids greatly in directing the so-called subconscious brain processes along profitable lines.

**Subconscious Mind Work.** — There is much evidence to the effect that we are conscious only of a minor portion of our mental activities — that the major portion occurs as unconsciously as the chemical processes upon which it depends. A name which we are unable to recall by voluntary effort often drops into the mind when we cease trying to recall it; suggestions received during the hypnotic state,

of the curriculum. The mind persists in expending itself along the line of its natural interests to the neglect of the studies.

or during ordinary sleep, tend to work themselves out in the waking period; and sometimes our most brilliant thoughts come apparently of themselves. Somewhat as breathing and the other vital processes go on without conscious direction, our thought currents, after being started, tend to evolve themselves automatically. The brain worker is naturally concerned in the proper direction and use of his subconscious processes.

**How to Use the Subconscious.** — Although the nature of the subconscious brain processes is not understood, the matter of utilizing them in mind work appears not to offer serious difficulty. For example, a minister, in speaking of his method of preparing sermons, said: "We ministers have a way of selecting a theme many days before the work of writing the sermon is begun. This theme with its related facts is kept constantly in mind — to be brooded over as it were. When the time for writing comes, it is found that the sermon has assumed its essential proportions and needs only to be put into the required literary form." The conditions observed by the minister and by all successful brain workers are four in number: 1. Interest in the subject which may be either natural or acquired. 2. A sufficient stock of material upon which the mind is to work. 3. The habit of concentration referred to above. 4. Persistent effort along the chosen line of work.

In addition to these conditions, the general attitude of mind is also an important factor in securing results. Since conscious effort tends to start subconscious processes,[1] and also has much to do with their general trend, this may be used as a practical means of

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[1] The principle upon which the subconscious mental processes act is closely akin to that of secondary reflex action (*Physiology and Hygiene*, page 314). As we develop reflex or automatic nervous mechanisms for the execution of definite muscular movements, such as walking, the movement of the hand in writing, etc., we also establish through conscious and repeated

**Training the Subconscious.** — The subconscious processes of the brain have been termed collectively the "understudy" of the conscious mind. This supposed relation has at least this basis of fact: the subconscious reflect to a very large degree the characteristics of the conscious mental states. They never apparently work independently of the conscious mind, but always in conjunction with it. Mental sloth and general inactivity are destructive of their efficiency, and half-hearted mental work elicits from them less than a half-hearted response. On the other hand, the mind that grips its work strongly, that enters upon its task with earnestness and enthusiasm, that is persistent in its efforts, will, through this mode of work, excite subconscious reactions of a most serviceable nature. Hence to train the so-called mental "understudy," we must see that the "master mind" itself is alert and efficient.

**Thought Harvesting.** — Only so far as his conscious processes are concerned, can the brain worker undertake to write a poem, paint a picture, invent a machine, or perform some other task which involves unusual effort on the part of the mind. The subconscious processes go on independently of our desires and conveniences. Just when certain finished, or half-finished products are to be born into the consciousness is beyond conjecture. Witness, for example, Archimedes receiving the solution of his problem in specific gravity while taking a bath, Mozart's conceiving a new musical creation while playing

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mental efforts, reflex brain mechanisms for thinking. Hence, as in mastering the technique of some musical instrument, it is the conscious effort that develops and makes permanent the mechanisms for subconscious work.

billiards, and Kekule's first grasping his theory of atomic arrangement while riding on the top of a stagecoach. Unless the brain worker writes down the mental products as they come to him, he is likely to lose many valuable thoughts.[1]

**Reading in its Relation to Mental Efficiency.** — With the recent remarkable development of periodicals and newspapers and with the increase in the publication of all kinds of books, the questions arise: What is the legitimate part which reading should play in effective mental work? Is there not danger that this form of mental activity may replace those of more vital concern?

With one line of reading, namely fiction, there is an actual danger. Fiction serves a legitimate purpose along the line of mental diversion and entertainment, is an important means of inculcating moral and ethical principles, and is an important agency for the portrayal of human character. Rightly used, fiction is a tremendous factor for good, but with many the reading of fiction tends toward a harmful excess, the habit being indulged to the extent of depriving the mind of its natural bent and activity. Too frequently does the novel reader live in a world of unrealities, the victim of an intoxication which in some respects is similar to that produced by drugs. So completely do the details of the plot and the personalities of the characters occupy the mind, that productive mental work becomes impossible. Though poor fiction is vastly worse in this respect than the works of approved authors, the extent to which the victim of the fiction habit carries his indulgence is pernicious without regard to the quality of the productions.

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[1] A visitor at the residence of Tolstoi, observing several lead pencils tied to the head of his bed with long strings, inquired their purpose. He was informed that this was a device for preserving the thoughts that came to him while in bed. Tolstoi, as many others have done, made frequent use, in time of recreation, of his note book. During horseback rides, of which he was particularly fond, his observers tell of frequent stops to write down his thoughts.

Another line of reading, pernicious both in its intellectual and moral effects, is supplied by our great daily newspapers. The publication of the details of crime and of court trials of people charged with crime supplies a species of mental diversion, the effects of which are decidedly harmful. These exciting narratives fill the minds of people to the exclusion of knowledge of real worth, supplying themes which draw off a disproportionate share of mental energy. But the moral effects are even more serious. Through suggestion (page 285), knowledge of the details of crime is a means of developing and fostering criminal tendencies in those to whom such knowledge is communicated. For this reason records of crime should be largely omitted in the daily distribution of news.

The amount and kind of reading in which one can indulge and still maintain his capacity for vigorous thinking, is a problem which the individual must solve for himself. In general it may be said that the sphere of reading is that of supplementing the mental processes and of supplying material for mental work. In so far as it replaces thinking, or diverts the mind from more profitable channels, it becomes wasteful in its effects.

**Mental Work and Rest.** — The earnest student is in constant danger of overworking. Overwork, through interference with the vital processes, limits both the quality and quantity of his work. The mind accomplishes most when there is a surplus of properly directed energy. If energy be lacking, the work is performed with more or less of strain, and strain should be avoided.

The periods of work should not be too prolonged. The student who begins his tasks at eight in the morning and continues them with only short intermissions till ten or twelve at night, is lessening rather than increasing his efficiency. If he desires to study late into the night, he should indulge in an hour or two of recreation and a half hour of sleep in the afternoon or evening. The night work will then be taken up with a rested brain and performed more effectively.

**Mental Efficiency and Drugs.** — Efforts to trick the brain, by the use of drugs, into doing more than its working capacity permits, can only end in failure. Temporary results are possible, as in the case of the person who drinks strong coffee in order to read late into the night, but such temporary results must not be accepted as a general principle. The extra draft upon the brain is from the reserve of nervous capital and must be repaid with interest, sometimes highly compounded. The law of the conservation of energy applies to the brain as well as to other energy-evolving contrivances. We cannot hope to get more out than we put in. If the drug enables us to get more out at a given time, greater exhaustion follows and a longer period of recuperation is thereby made necessary. Any seeming need for stimulants that may exist is only indicative of a run-down condition of the body, the remedy for which is not drugs, but a closer observance of the laws of health.

**The Physical Equipment.** — The success of the brain worker will depend, in a measure, upon the physical appliances through which he gives expression to his thought, and like the mechanic, he is to be judged to some extent by his tools. The artist wastes time and energy if his pencils, brushes, and paints are poor in quality. The scientist loses time, and is inaccurate in his results, if he is not equipped with reliable apparatus. Whatever the physical instrument required, the effective use of the mental powers requires that it be selected with care and kept in the best condition.

Those whose work involves much writing are unanimous in their recommendation of the typewriter as an aid to efficiency. One who has mastered the touch system of typewriting, writes faster, more legibly, and with less effort than with pen or pencil. On account of the ease with which typewritten copy can be corrected, the final product is also much more satisfactory. Simply as an interesting accomplishment, typewriting also has much to recommend it.

**Utilization.** — Upon the question of how, or upon what, the individual shall expend his mental forces, a work on hygiene is not ordinarily supposed to deal. Since this question involves the proper disposition of the nervous energy, however, it has a hygienic bearing too important to be ignored. There can be no doubt but that a chief difference between people who accomplish things in a mental way and those who do not, is largely a question of utilization. Some set their minds to work upon things of serious moment, and observing the necessary conditions, achieve results. Others of equal or greater ability permit their mental forces to be expended upon trivialities and accomplish nothing. To merit attention, or even to prove that one possesses mental ability, the mental forces must be transformed into tangible products of human accomplishment, and this requires earnest, persistent, and well-directed effort.

**Mental Efficiency in its Relation to Age.** — Though one completes his physical development at twenty-five, and quite frequently at a younger age, full mental efficiency is not attained until a much later period. This difference is explained in part by the nature of the cerebrum, the organ of the mind. This highly developed adjunct of the human being was, in the process of evolution, the last of the bodily organs to unfold. Hence in the repetition of the general evolutionary process, which occurs in the growth of each individual, the cerebrum is the last to attain its full development and the last to attain its full functional maturity.[1] In the nature of mind itself is also found a cause for the late development of full efficiency. Time is necessary for the aquisition of knowledge and for rendering the mental processes accurate and reliable through experience.

The ability to learn, or to take up new lines of mental effort, is apparently not peculiar to any period of life, though somewhat more pronounced in youth. "It is false," says Forel, "to believe that we have to learn only in youth; we have never finished." [2]

**Conditions for Full Development.** — Serious loss also results to the brain worker who fails to attain that degree of mental power of which he is capable. Unfortunately we are without standards which enable us to know when full development of the mind has been attained. We have our standards of physical development, but the nature of mind is such that the individual can only know that he is attaining the development of which he is capable when he is supplying constantly the conditions upon which the continued growth of mind depends. These as already suggested are two — continued bodily vigor and continued mental work.

Too frequently is the mistake made of stopping vigorous mental work on the completion of a course in some college or university or upon the attainment of professional or technical knowledge sufficient for entering upon a vocation. This should serve merely as a preparation for the life of serious mental effort to follow.

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[1] Though the brain attains its full size before other parts of the body, the blending and connecting of neurons through the multiplication of their branches, and the formation of fiber coverings, continues long after growth in the other organs has ceased. — See Donaldson's *Growth of the Brain*.

[2] Forel, *Mental and Nervous Hygiene*.

Upon the general necessity of keeping up bodily vigor, enough has already been said. However, if the saying of more would impress this basic principle upon those following mental occupations, further repetition would indeed be worth while. Failure on the part of the brain worker to solve his problems of health, to place his life processes, so to speak, upon a scientific basis, is sure to interfere with the intellectual result toward which he strives. The many brilliant careers that have been curtailed through loss of bodily health and early death leave no doubt upon this point.

**Mental Efficiency and Old Age.** — It is a popular error to attribute the decline in mental efficiency of those ages from 60 to 75, to advancing years. Mental efficiency is lost during this period for the same reason that people lose it in the preceding periods, i. e., from loss of health and from cessation of vigorous mental work. People from 60 to 75 who keep well and who keep mentally active retain their efficiency; those failing to supply either of these conditions, lose it. It is a fact, however, that the problem of keeping well becomes more difficult as one advances in years, and because old people are more apt to lose their health, they are also more likely to become inefficient mentally. The solution of the problem, therefore, lies largely in the domain of hygiene (page 220). As we become more familiar with the health problems of old people, we may confidently look for improvement, both in the prolongation of life and in the maintenance of efficiency.[1]

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[1] Proof that the decline in efficiency of those between the ages of 60 and 75 must be accredited to ill health and improper methods of living and

That the matured fruit of mental efficiency often comes late in life is a matter of historical record.[1] While brilliancy and mental capability may manifest themselves at an early age, many like Moses of old perform their greatest service in their closing years. The problem of prolonging the period of mental efficiency is, therefore, of more than passing interest. Its solution will not only enhance the value of life for the individual, but will broaden the outlook of humanity as a whole.

**Mental Efficiency of School Children.** — The two conditions for the development and maintenance of mental efficiency in adults apply with equal force to the army of little workers who attend our public schools. All over our land the mistake is being made of attempting to develop the mind while ignoring the fundamental needs of the body. In numerous instances the educational gains are more than offset by serious bodily losses, so that the child is injured mentally by his attendance at school. Upon teachers and school officers devolves the responsibility of seeing that conditions essential to the health and growth of children are supplied, and the hopeful aspect of the situation is that these are realizing, as never before, their responsibility.

working rather than to conditions associated with advancing years, is found in the very large number who have maintained a high grade of efficiency to 75 and beyond. The roll includes Goethe, Gladstone, Tolstoi, Edward Everett Hale, Professor Goldwin Smith, Mark Twain, William Cullen Bryant, John Bigelow, Alfred Russel Wallace, Lyman Abbott, Chas. W. Eliot, John Burroughs, and a host of others, many of whom are alive and at work today. The number is simply too great to be accounted for on grounds other than that efficient mental life in advanced years is a *natural* state, attainable by all who fulfill the conditions.

[1] Dorland in his *Age of Mental Virility* presents a careful compilation and analysis of the records of four hundred of the world's most noted mental workers, selected from all fields of activity. The conclusion reached by this extended study is that the zenith of intellectual achievement is attained at about 50 years of age and that there is no age limit to efficient mental work, provided "one keeps up his health and his enthusiasm for mental effort."

Already much progress has been made along the lines of physical education, and this will no doubt continue.

**Summary.** — Mental work, because of the slight demand which it makes upon the bodily organs, fails to secure general activities essential to health. Hence, if followed to the exclusion of physical exercise, it becomes a cause of weakness and disease, defeating withal its special aim and purpose. To avoid harm to the body and to reach a high degree of mental efficiency, all the conditions making for good health and bodily vigor must be supplied. One must also apply his mental energy in an economical manner and avoid overwork, strain, and the use of drugs. The two arch enemies of mental efficiency are bodily weakness and the cessation of serious mental work; either may quickly destroy a power which required years to develop. One must keep mentally alert, constantly working in, as Forel says, "new mental activities," and he must keep well. If these two conditions are maintained, he may confidently hope to realize in his own life the ideal of the prophets and the sages — mental efficiency in advancing years. Serious mental work begins when the child starts to school, and the physical conditions which are essential to the success of the adult brain worker are even more essential in the developing days of youth.

**Exercises.** — 1. In what different ways is a sound mind dependent upon a sound body?

2. What harmful results are liable to arise when mental work is carried on without conscious attention to the needs of the body?

3. Account for the general tendency of the brain worker to neglect his health.

4. Compare the effects of mental and of physical work upon the body. Why is it impossible to carry on mental work for some time without more or less of physical exercise?

5. To what bodily conditions should the brain worker give constant attention? Explain in each case.

6. Enumerate the different ways by which mental energy may be conserved. How may exercise of the muscles increase the energy of the brain?

7. How must the farmer manage his soil if he would obtain the maximum yield from year to year? Does the brain worker have a similar problem in the management of his body? Explain.

8. By what means may the mind be kept upon a given task? What is meant by "mental rubbish"? Illustrate. How is mental rubbish to be disposed of?

9. How is the habit of concentration formed? What are its advantages?

10. To what extent may brain processes occur unconsciously? What methods of mental work call into effective action the subconscious processes?

11. How may reading aid, and how interfere with, effective mental work?

12. How does the use of stimulants diminish, rather than increase, mental efficiency?

13. Compare the time required for body development with that required for the full development of the mind.

14. What method of living, and of work, must be followed if one is to attain the full development of which his mind is capable?

15. How is it possible for the brain worker sometimes to accomplish more by shortening his hours of work?

16. How is mental efficiency to be maintained during advancing years? How do people lose mental efficiency during all periods of life?

17. Enumerate the physical needs of school children. How will attention to these needs improve the quality of their work?

## Health Work

On account of the special demands made upon the efficient brain worker and because of his natural inclinations and tendencies, health conditions are very apt to be neglected, even when the results of such neglect are fully understood. Hence it is not wise to depend upon irregular effort for putting back into the body the vigor and vitality that are daily withdrawn, but to form such health-giving habits as have already been suggested and so plan the daily routine that these are kept up. This brings us to the consideration of

**A Daily Health Régime.** — There should be such an arrangement of the schedule that each day's exercise, rest, relaxation, and sleep will come in orderly sequence with the appointed tasks and duties. The following schedule, prepared by a summer school student who desired to get the most out of his body in the way of mental work and to keep up his health and efficiency at the same time, will suggest the general plan:

5.45 A. M. Rise, dress, drink a glass of cold water, and take a brisk walk of from 15 to 20 minutes.
6.30 A. M. Breakfast.
7.00 A. M. Toilet, after which prepare for the serious work of the day.
8.00 A. M. to 12.00 M. Work.
12.30 P. M. Dinner followed by 30 minutes of rest and relaxation.
1.30 P. M. to 4.30 P. M. Work.
4.30 P. M. to 6.00 P. M. Rather vigorous outdoor exercise.
6.30 P. M. Supper.
7.00 P. M. to 8.00 P. M. Rest and, if possible, sleep.
8.00 P. M. to 9.45 P. M. Work.
9.45 to 10.00 P. M. Special exercises in room for adjustment of shoulders and spine and for developing the muscles of the back, neck, and abdomen (page 65).
10.00 P. M. to 5.45 A. M. Sound sleep.

While such a régime should be modified to meet the needs and convenience of the individual, and should be varied with the season, the weather, and other conditions, it should be followed as closely as existing circumstances permit. Its importance to the brain worker can scarcely be overestimated. Indeed, it is only by setting up some such ideal and diligently working toward it, that he can hope to preserve for the future, the health and efficiency which are his for today.

**To Combine Mental and Physical Work.** — Those who have studied the problem carefully agree in the opinion that the brain worker fares better with moderate exercise distributed throughout the day than by an hour or so of strenuous exercise taken at one time. In keeping with this idea, attempts have been made to combine to some extent the physical and mental activities. Ways by which this may be accomplished are as follows:

1. In reading, writing, or other desk work, the person sits up straight without support from back of chair, using the trunk and neck muscles for maintaining good posture (Fig. 22).

2. The working position is changed frequently, and if the mind becomes sluggish, the chest lifting exercise (page 91) is taken, or one gets up and moves about.

3. A sidewall shelf (Fig. 68) or desk is provided in the study, whereby one can perform a part of his mental work in the standing

position. The reporter's method of note-taking while standing or moving about may also be followed.

4. If a teacher, the recitation is conducted in the standing position.

5. The mind is kept busy during the periods of recreation and of physical work, provision being made through notebook and pencil for writing down thoughts which come at these times.

**To Recover from Effects of Mental Overwork.** — While many are able to regain nervous health through vacation trips or sojourns at "health resorts," more definite results can often be accomplished at home through hygienic agencies. One desiring to build up his nervous system should supply the following conditions:

1. Sufficient exercise each day to produce physical weariness on retiring. Exercise by equalizing the circulation relieves a tension (sometimes a high blood pressure) and makes for sound sleep and the ability to relax.

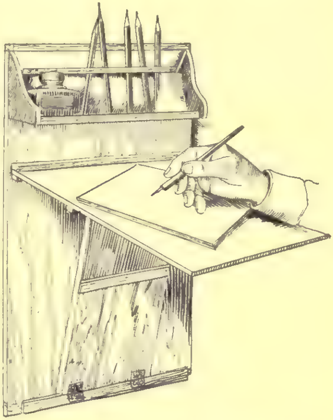

FIG. 68. — **A Convenient Side-wall Shelf** for writing while standing. An easy method of combining mental work with physical exercise.

2. Plenty of sleep, giving attention to all the conditions (page 249) that secure sound sleep.

3. A well-balanced diet and a good degree of digestive vigor (Chapter IX), avoiding both undereating and overeating.

4. Rest for the eyes. What appears to be nervous exhaustion is often nothing more than eyestrain with its accompanying results (Chapter XIII).

5. Omission of serious mental effort of all kinds.

The better plan is, of course, to avoid nervous exhaustion altogether, as may be done by supplying *each day* the conditions upon which nervous health depends.

# CHAPTER XVI

## GERM FIGHTING: DEFENSIVE METHODS

"It is within the power of man to cause all infectious diseases to disappear from the earth."— *Pasteur.*

MUCH of the uncertainty of life and health comes from the liability to attacks of micro-organisms — the so-called germs of disease. Germ diseases are responsible for most of the deaths that occur before middle age, and in no period of life does one gain complete immunity from them. In our ability to repel the attacks of germs and to prevent their development is found a means of control whose importance is beyond calculation.

**Our Invisible Enemies.** — Through the aid of the microscope the biologist has discovered some hundreds of kinds of minute life-forms which become exceedingly abundant under conditions favoring their development. Such of these as belong to the vegetable kingdom are known as *bacteria;* those belonging to the animal kingdom are known as *protozoa.* Many species of bacteria and a few species of protozoa have become adapted to living within the human body and upon its surfaces, and there reproducing themselves in vast numbers.[1] Through the destruction of cells and by the secretion of poisons (toxins) highly injurious to the nervous system, they produce the conditions recognized as disease. After developing in the body of one person they find some means of passing to others where they start the disease afresh. The term *infection* is used to designate the successful entrance of harmful germs into the body.

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[1] The fact should be noted that many kinds of micro-organisms are not harmful and that a few are to be classed as our friends rather than our foes. A species of bacteria, for example, which lives upon the roots of leguminous plants enables these to combine the free nitrogen of the air with other elements, thereby forming compounds that enrich the soil.

**General Methods of Germ Fighting.** — The body is in unceasing conflict with the germs of disease, waging a warfare which, like the bloody conflicts between nations, may be either defensive or offensive. By repelling germ attacks and by strengthening the body's resistance, we fight defensively; by destroying germs before they reach the body and by removing conditions upon which their existence depends, we fight offensively. As in ordinary warfare also, success depends largely upon the knowledge at our command and the energy with which this knowledge is applied. Much credit is due the scientists and physicians whose painstaking efforts have made it possible to wage successful war against our invisible enemies.

FIG. 69. — **Louis Pasteur** (1822–1895). A distinguished biologist whose researches laid the foundation for present knowledge of the causes of transmissible disease and of modern methods of prevention. His discovery of a successful treatment for hydrophobia has been the means of saving thousands of lives.

**The Body's Defenses.** — Much of our knowledge of methods of protecting the body against germ attacks has been obtained by study of its natural modes of defense (Fig. 70). Disease germs do not originate in the body spontaneously, but must enter it from without. To prevent such entrance, the body employs its external coverings — the skin on the outside and the mucous linings within. The latter protect the food canal, the air passages, and other parts connected with the external surface. The skin and mucous linings form the outer defenses of the body fortress. Should bacteria effect an entrance they are then opposed by the germ-destroying cells of the body, the *white corpuscles*, and by certain chemical agents in the blood, known as *opsonins*. A further means of protection is supplied through the lymph nodules (*E*, Fig. 70), the gland-like structures situated upon the main lymphatic tubes and garrisoned by white corpuscles. These separate the germs picked up by the lymph in its return to the blood and, through the white corpuscles, destroy them. In addition to these general modes of defense, special changes are brought about in the body fluids, through the attacks of certain diseases, which enable the body to protect itself against future attacks. Conscious effort in defending the body against germs consists, for

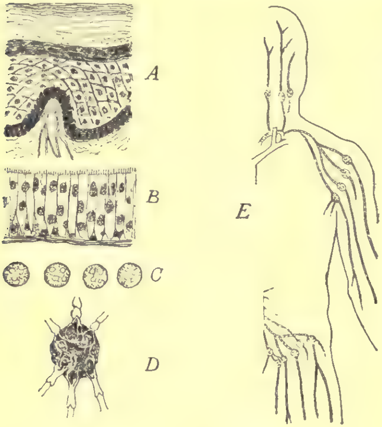

FIG. 70. — **Some of the Means Employed by the Body** in defending itself against invasions of germs. *A*. Section of the skin. *B*. Epithelial cells for protecting the air passages. *C*. White corpuscles — the germ-destroying cells of the blood. *D*. The lymph nodule, a device for separating germs as lymph is returned to the blood. *E*. Location of important groups of lymph nodules.

the most part, in strengthening and supplementing its natural defenses.

**To Prevent Germ Invasions through the Skin.** — A chief function of the skin is that of protecting the body from germs, a function devolving mainly upon the outer layer, or cuticle. Weak places in the cuticle are found at the roots of the hairs and at the openings of the oil and sweat glands, and it is through these that the germs causing boils, carbuncles, and other skin diseases sometimes find entrance. The greatest danger of germ invasion through the skin, however, is from the numerous wounds, large and small, which it receives. Every wound is a breach in the wall through which the foe may enter. Though the blood and lymph supply additional defense against such attacks, the occasions are frequent when this is not sufficient.[1]

**The Use of Germicides.** — Effective resistance to the entrance of germs through skin wounds is found in the proper use of certain chemical agents, called germicides. These are prepared in such strength as to destroy the germs, but not, as a rule, in such strength as to injure the tissues upon which they are placed. A fresh three per cent solution of hydrogen peroxide (weakens rapidly if not kept cool and away from strong light) supplies these conditions as does also a valuable ointment, consisting of ichthyol, lanolin, and yellow vasoline, which is compounded by the druggist.[2] A number of other substances (grain alcohol,

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[1] As the general tone of the health is lowered, the constituents of the blood become less able to destroy germs. The nature of the wound and the kind of germs may also be such that insufficient resistance is offered by the blood.

[2]

| | |
|---|---|
| Ichthyol | 6 grams |
| Lanolin | 25 grams |
| Yellow Vaseline | 20 grams |

This ointment is of special value in the treatment of minor infections, such as pimples, boils, styes, and sores resulting from neglected skin a four per cent solution of carbolic acid, a ten per cent solution of potassium permanganate, etc.) are also recommended, but the two above named are sufficient for most purposes. The peroxide, applied as a wash, or the ointment smeared over and worked well into the sore, will suffice as a treatment for small cuts, scratches, bites of insects, and other wounds of a mild nature. The wound should of course be treated as soon as possible after it is received.

The necessity for the use of simple germicides is found in the fact that skin wounds, insignificant in themselves, may lead to results most serious. The scratch of a pin, the bite of an insect, a slight abrasion from a splinter, nail, or tool, or even a bruise, may open the way for germ invasions that may destroy life itself. Moreover, one never can tell when serious consequences are likely to follow. By the use of germicides the possibility of harm is removed.

**Skin Wounds Needing Radical Treatment.** — For all serious wounds the aid and advice of a physician are necessary, but if there be delay in securing his services, valuable time need not be lost if proper materials are at hand and one knows how to use them. A deep wound from a rusty nail or a tool which has been contaminated with some kind of filth, should be well opened and cleaned, and treated with strong, or undiluted, carbolic acid. In applying the acid, it is best to use a pointed splinter (a new wooden toothpick is well adapted to small wounds), this being dipped into the acid and worked well into the

wounds. It does not injure the most delicate tissue, but in most cases gradually brings about the destruction of germs. It is applied as a thin layer on the surface, except in the case of boils or abscesses. In treating these a heavy layer is spread over the affected part which is then covered with absorbent cotton or a thin piece of cotton cloth. This is renewed once or twice a day until the infection has disappeared.

opening. Little pain is felt, the acid itself benumbing the nerves, and the destruction of germs is made certain by prompt application. After the administration of the acid, the wound is thoroughly washed and bound up, but if large is kept open so that the healing is from the bottom.[1]

Wounds from explosives, including Fourth of July accidents, should be treated in the same radical manner and should have the attention of the physician. The chief danger from deep wounds is from the germs causing tetanus, or lockjaw. These are frequently present in rich soils,[2] and for some unexplained reason are frequently associated with explosives. In the list for radical treatment must also be placed wounds from the bites of domestic animals. The harmful germs, including those of hydrophobia, which may be present in the mouths of animals, make this precaution necessary. In all cases where there is danger from tetanus or hydrophobia, the physician should be called at once, even if the above precautions have been taken, since special treatment may be necessary to fortify the body against their development (pages 338 and 340).

**Danger from Insects.** — In addition to the danger arising from germs on the skin or clothing finding an entrance through small wounds made by insects, there are certain species of germs that live within or upon the insects themselves and which find an entrance through the small wounds that these inflict (Chapter XVII). Again, the bites of certain insects produce more or less of itching and this causes the wounds to be scratched. The scratching may cause abrasions through which germs from the nails, the skin, or the clothing, find entrance. Mild germicides often lessen the itching, and if applied to the bites of such insects as chiggers, wood ticks, and fleas, serves the double purpose of allaying irritation and of preventing infection.

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[1] Tincture of iodine, prepared according to the formula of the U. S. Dispensary, may be used instead of the carbolic acid. This is less dangerous to keep about the home and coagulates albumin to a much less degree than the acid.

[2] The germs of tetanus are most frequently found in the débris accumulating about barnyards and in soils fertilized by them, there being considerable evidence that they develop in the intestines of horses, passing out with the feces.

**Liabilities from the Feet.** — Many cases of blood poisoning[1] start from infections of the feet. Misfitting shoes and stockings develop corns, bunions, and ingrowing toe nails, and also cause sores between the toes and blistering of the soles of the feet. Infection may start either from the sores themselves or from uncleanly methods of treating them. The weak germicides already described may be used on any and all kinds of foot wounds, and in attempting to relieve a corn or an ingrowing toe nail, one of these should be applied if only the smallest wound is made. Better than any kind of treatment, however, is the avoidance of such inconveniences by the use of hygienic foot-wear. Sores between the toes from the perspiration are prevented by small pads of absorbent cotton, and ingrowing toe nails are completely avoided by properly fitted shoes and by scraping the entire upper surface of the nail until it is quite thin. The danger of foot infections renders the childish custom of going barefooted highly dangerous in some localities (page 360).

**Germ Entrance from the Food Canal.** — Fortunately germs that may be in the food canal have yet to penetrate the outer layer of mucous membrane, called the *epithelium*, before they can enter the body proper. This layer offers sufficient protection, when in a sound condition, except in the case of typhoid fever. The germs of this disease find entrance in the healthy individual through the small lymphatic glands in the small intestine, known as *Peyer's patches*. There are numerous liabilities, however, of breaking the epithelium, and in such cases its protection becomes uncertain. Wounds in the epithelium may arise from the presence of rough, indigestible materials accidentally swallowed, from coarse foods imperfectly masticated, and from the hardened feces resulting from constipation. The bites of parasitic worms inhabiting the food canal also open up the way for attacks of germs as do the bites of insects upon the skin. These liabilities suggest certain necessary precautions.

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[1] Infections are said to be *local* when the germs are confined to the sores at the place of entrance and *general* when they spread from here to different parts of the body. Blood poisoning is a form of general infection in which the germs are carried by the blood.

**Avoidance of Living Germs.** — The most important general defense against all germs likely to enter the body through the food canal is that of using only sterilized food and water. Heat destroys all forms of life, and food which is thoroughly cooked, and eaten before it is again exposed, can introduce no harmful bacteria. Water containing typhoid and other germs is rendered harmless by thorough boiling. If boiled one day and set aside until the day following, it takes up fresh air and this renders it agreeable to the taste. Metchnikoff is most insistent upon the point of thorough cooking, advising the cooking even of strawberries and finely flavored fruits, as well as all vegetables, before they are eaten.[1] Meat is especially dangerous if eaten raw or when only surface-cooked, since it is liable to contain animal parasites as well as bacteria (page 146). It may also be noted that thorough cooking renders most food more digestible and improves its flavor. Milk likely to contain harmful germs should either be boiled or

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[1] Metchnikoff, *The New Hygiene*.

Pasteurized (heated to a temperature of from 65° to 75° C. for a period of 20 minutes) before being used.[1]

**Avoidance of Stomach and Intestinal Irritation.** — Since it is impossible to keep the food canal entirely free from living germs, it is necessary to maintain such a healthy condition of the mucous linings that they can find no places of entrance. This is accomplished by avoiding all the conditions that tend to irritate and weaken the mucous surfaces. Especially should any tendency to indigestion and constipation receive prompt and careful attention.

Indigestion is usually attended by the decomposition of foods and the formation of chemical irritants (acids, etc.), and these produce, sooner or later, a weakened, nonresistant surface. The hardened feces resulting from constipation, cause mechanical irritation and may even wound the delicate lining. If along with these conditions there be inactivity of the liver, so that the intestines are deprived of the antiseptic and lubricating effects of the bile, appendicitis and other diseases resulting from germ attacks are likely to occur. Hence the avoidance of indigestion and constipation are imperative. If hygienic measures fail to give relief (Chapter IX), a physician must be consulted.

**The Nature of Appendicitis.** — Appendicitis is an inflamed, and sometimes ulcerated, condition of the *appendix vermiformis*, the small tube attached to the lower end of the large intestine, on the right side. It is attended by tenderness over the appendix, by intense pain in the right lower quarter (and sometimes other parts) of the abdomen, by fever, and, in advanced cases, by swelling and the formation of pus. If in the culmination of the attack, the pus discharges into the large intestine, recovery follows, though further attacks are highly probable. If the discharge is into the abdominal space outside of the intestines, as occurs when the wall of the appendix is ruptured, the result is usually fatal. On account of this danger, the preferred treatment is that of a surgical operation for the removal of the appendix. Better, however, than an operation is the avoidance of the disease itself, as is possible in most instances.

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[1] A simple method of Pasteurizing milk is to place the bottle of milk, as it is delivered by the milkman, in a tall vessel of water and heat until the water begins to boil. The milk and the water are then allowed to cool together. Enough germs are destroyed by this means to render the milk safe, while its taste and digestibility are not altered. For ordinary purposes heating the milk just to the boiling point is the simplest and most satisfactory method. The time will probably come when the drinking of raw milk will be considered as unhygienic as is now the eating of raw meat.

**Preventive Measures.** — Though appendicitis originates from a variety of causes — hard substances getting into the appendix, strain in lifting, a blow over the appendix, colds, etc., — the more general cause is an enfeebled condition of the entire food canal, the result of chemical and mechanical irritation, which renders the mucous lining susceptible to attacks of germs. Such attacks are not limited to the appendix, but occur most frequently at this point because of the general weakness of the organ, the fact that its position enables substances to gravitate into it, and its shape (slightly larger at the lower end) which favors their retention.

Chief among the measures for the prevention of appendicitis is the avoidance of chemical and mechanical irritation. Keep down chemical irritations by securing good digestion, limiting the use of acid substances, and avoiding an excess of sugar. Keep down mechanical irritations by thorough mastication, by the use of plenty of water, and by the avoidance of constipation. It is well also to avoid the mechanical causes that might bruise the appendix or force materials into it.[1]

**Germ Entrance from Air Passages.** — The air passages are the most vulnerable of the body defenses. This is because of the extensive and delicate mechanism for the introduction of oxygen and the removal of carbon dioxide. It is also true that the field of hygienic effort relative to the respiratory processes is greater than that of the skin or the digestive organs, especially in the matter of preventing attacks of germs. While such effort consists in most instances in making a proper use of what nature already provides, it is necessary in some cases to supplement the natural defenses and to remove obstructions to the free movement of the breath.

**The Nostrils, the Outer Defense of the Air Passages.** — In the general plan of defending a country, fortifications are constructed at the places of entrance, such as harbors and the mouths of rivers. Through the nostrils nature has supplied a somewhat similar defense for the air passages. These provide a device for separating dust particles and germs from the air and for warming and moistening the air before it enters the lungs. In the lining of the nostrils also is a delicate nervous indicator, the sense of smell, which, as a watchful sentinel, gives timely warning when foul gases are being breathed or when decaying and germ-laden substances are about to be eaten.

If one is careful to breathe through the nostrils, instead of using the mouth, this fact alone will decrease the liability to germ invasions through the air passages. Microscopic examination of the secretions from the nostrils supplies ample proof of their ability to separate germs from the air and to destroy them. Mouth breathing must be avoided, even if unusual means have to be resorted to for this purpose.

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[1] A point of theoretical interest is the opinion, held by some authorities, that the gases resulting from fermentation in the intestines, tend to press open the appendix, making it possible for the fecal matter to find an entrance.

**Surgical Operation Sometimes Necessary.** — Mouth breathers are usually so from necessity rather than from habit. Obstructions in the nostrils and the upper pharynx render nose breathing difficult and sometimes impossible. The nostrils may be obstructed either by projecting bones or by abnormal growths (nasal polypi) from the mucous surface, while the upper pharynx is frequently plugged by adenoids. Since the individual himself is unable to remove these obstructions, his only recourse is that of a minor surgical operation. Such operations are performed daily by nose and throat specialists and are attended with little pain or danger. And the result makes such a difference! Children from whom adenoids have been removed have simply been transformed — their health and physical appearance being greatly improved and also their ability to carry on school work.

**Germ Colonies in Upper Air Passages.** — The nostrils and the throat, on account of their exposed positions, are especially liable to attacks of germs. Finding vulnerable places upon the moist membranes, the germs establish homes, so to speak, where they live and propagate their kind. They secrete toxins which excite local irritation and which, on being taken up and distributed by the blood, interfere, through the nervous system, with the work of the body generally. A number of diseases, including diphtheria, grip, meningitis, colds, measles, and scarlet fever, have their beginning in germ colonies at these places. It is necessary, therefore, to prevent the establishment of such colonies and to rid ourselves of such as have already been formed.

**Remedial Measures.** — If the outer fortifications of a country have weakened from any cause, ordinary prudence suggests that they be strengthened. For a similar reason an earnest effort should be made to increase the resistance of the throat and nostrils when these have become vulnerable to attacks of germs. To this end both hygiene and medicine are often necessary. Hygienic conditions generally, such as have been discussed in preceding chapters, are of importance, for as we strengthen the body as a whole we increase the resistance of its parts. Neck exercises (page 66), massage of the external throat surfaces, and avoidance of neck-wear which interferes with freedom of motion or unduly protects this part of the body, all have the effect of improving the circulation in the region of the neck and of strengthening the mucous surfaces.

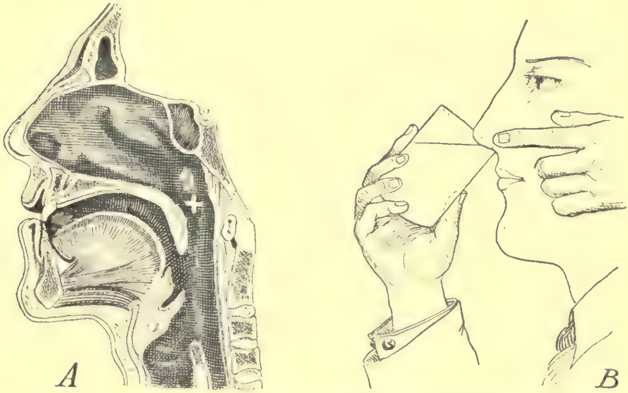

FIG. 71. — **Relations of the Nostrils, Pharynx, Mouth, and Larynx.** The connection of the eustachian tube with the upper pharynx (shown above small cross in *A*) causes the snuffing of liquids to sometimes produce inflammation of the middle ear. When such treatment is necessary the liquid should be gently drawn through the nostril (*B*) or applied with an atomizer.

Outdoor life and exercise and good ventilation of living and sleeping rooms also improve the mucous surfaces as explained below.

For the dislodgment of germ colonies already present, medical aid is usually necessary. Mild antiseptic solutions used as a gargle for the throat or as a wash for the nostrils (drawn gently through the nostrils separately, from a tumbler, as may be done by closing one nostril with the finger [*B*, Fig. 71], or applied to both the nose and the throat with an atomizer), give in most cases the desired relief.[1] In cases of chronic catarrh and sore throat, however, office treatment is usually recommended. The physician, by skillfully applying remedies too strong to be trusted to the patient, is able to dislodge the enemy.

**Tonsils a Weak Spot.** — Unhealthy tonsils are with many people a serious menace to the general health. A source of nervous irritation and a cause of rheumatic pains, the enfeebled and swollen tonsil is a fertile field for the propagation of germs. The best remedy for the diseased tonsil is, in most cases, a minor surgical operation for its removal. As in the case of adenoids, the removal often has a beneficial effect upon the body in general. Medical treatment, however, frequently brings about permanent improvement, especially when the body is invigorated through outdoor life, exercise, and other hygienic agencies. Massage of the tonsil from the outside is sometimes of value from its effect in improving local circulation.

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[1] The simple matter of cleansing the nostrils with a solution of salt in water (just enough salt to smart the nostrils slightly), will tone up their surfaces and greatly improve their resistance. In mild cases of catarrh this is frequently a sufficient remedy. The solution must be applied with care, however, since there is danger of forcing liquid into the eustachian tube (Fig. 71) and causing inflammation of the middle ear.

**To Increase Respiratory Resistance.** — The great frequency of such serious diseases of the lungs as pneumonia and tuberculosis, makes the methods for increasing the resistance of these organs of the first importance. One with weak lungs should spend much time out of doors, exercising to the extent that his strength permits, and he should form the habit of full breathing (pages 103–105). He should take every precaution against colds (page 344), and should have a liberal diet of nourishing food. Protection by clothing should be ample, but overprotection, especially of the chest, should be avoided.[1] Overprotection of the chest is weakening to this part of the body and diminishes rather than increases respiratory resistance. A sounder principle of hygiene is expressed in the oft-quoted statement that "the best place for a chest protector is upon the feet."

**Mucous Surfaces and Outdoor Air.** — Of special interest is the beneficial effect of outdoor life upon the mucous linings of the air passages. One going out of doors on a cold day will observe a marked increase in the secretions of the nostrils. Since this secretion is antiseptic, it destroys newly-formed germ colonies as well as cleanses the surfaces. What is true of the nasal secretions is true to some extent of the secretions of the throat and lungs. The effect derived through the improved secretions, together with results attained from the deeper breathing, the increased activity of the temperature regulating mechanism (page 198), and the fresh air itself, combine to make outdoor life the greatest of all agencies for improving the air passages. Proofs of this are found in the results from outdoor treatment for pneumonia and tuberculosis[1] and in the effects of outdoor air upon the minor affections of the air passages. A persistent cold often disappears quickly when the time spent out of doors is increased.

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[1] On account of the unequal distribution of material about the chest in men's clothing — coat and vest both being extra heavy in front and thin behind — it is sometimes advisable for men reduced in health to provide additional protection for the back and shoulders.

For the otherwise well person with weak lungs, the practice of sleeping out of doors is to be recommended, precautions of course being taken to protect the body from cold and wet. An upstairs sleeping porch, enclosed by wire screens, and opening out from a room in which one can dress, is the most satisfactory arrangement (Fig. 72). When this plan is carried out in moderation,

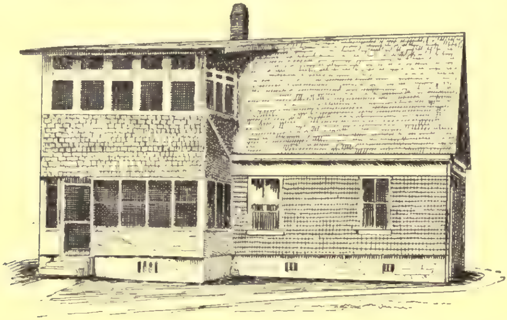

FIG. 72. — **A Protected Sleeping Porch.** This porch faces south, the north side opening into a warm room. Regular sash are fitted in the windows, inside the screening, for avoiding severe draughts. The screened-in lower porch is used as a place for dining in summer.

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[1] The three essential features in the so-called outdoor cure are rest, a nourishing diet, and the spending of practically all of one's time out of doors. Not only should one keep out during the pleasant months of summer, but also during the cold months of winter. Severe exposure is prevented by overhead protection at night and by sufficient clothing to keep the body warm. The abundant supply of pure, cold air strengthens the lungs and invigorates the entire body, raising its resistance to the point where the disease can be thrown off.

omitting stormy nights and those that are intensely cold, good results follow. The best time to begin outdoor sleeping is during the summer or fall.

**General Resistance.** — If germs succeed in entering the body, they are opposed by internal forces, referred to as the body's resistance.[1] This inner defense or resistance is of two kinds, — a general resistance to all varieties of germs and a specific resistance to the germs of particular diseases. The general resistance is supposed to depend directly upon the white corpuscles and upon the opsonins (page 320) of the blood. The white corpuscles first absorb or engulf the invading germs, after which they digest and assimilate them. The opsonins in some way cause the germs to be taken up more rapidly by the white corpuscles. This being in brief the method of resistance, can the individual do anything to improve it? He can do much, and for the reason that the effectiveness of his resistance is closely related to the state of his health. As the health improves the general resistance rises, and as the health declines it falls. Hence by attention to the conditions upon which good health depends one is able to maintain and improve his general resistance.

**To Guard the General Resistance.** — If the general resistance drops but for a brief interval, harmful germs may become established within the body.[2] It is a common observation that germ attacks frequently follow severe exposure or exhaustion. A small boy spends the day skating and a day or so later takes scarlet fever; an adult comes down with typhoid after a few days of overwork; a nurse contracts the disease of her patient after some nights of wakeful attendance, etc. These occurrences are explained on the ground that the exposure or exhaustion reduce the general resistance and thus enable the germs, already present in the air passages or the food canal, to effect an entrance or to develop in numbers sufficiently great to cause harm.

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[1] The term *local resistance* is occasionally used in contradistinction to general resistance. The resistance of an organ or part of the body due to the skin or its mucous linings may be referred to as local resistance.

[2] Proof of the importance of general resistance in the prevention of disease is supplied by an experiment that Pasteur made upon a chicken. He found that the chicken under normal conditions had a natural resistance to the germs of anthrax and showed no signs of this disease when inoculated with large numbers of the germs. But if the chicken was immersed in cold

That bodily resistance should be carefully guarded is self-evident. Especially in times of unusual liability — outbreaks of epidemics, care of those sick with infectious diseases, etc. — should we avoid conditions, such as overwork, protracted chilling, loss of sleep, nervous exhaustion, overeating, extreme hunger, and dissipation, which, by lowering the tone of health, lower the general resistance. In the prevention of no single disease perhaps is the keeping up of the general resistance more important than in the case of pneumonia.[1]

**General Resistance and Pneumonia.** — A distinguished pathologist[2] says that "any circumstance that leads to a lowered vitality may be a predisposing or contributing cause (of pneumonia), such as previous attacks, wasting diseases, pulmonary lesions, traumatism (mechanical injury) of the lungs, bodily injuries, chronic nervous disorders, and exhausting occupations." The immediate

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water and inoculated while chilled, anthrax developed. Chilling destroyed the chicken's resistance to the anthrax germs. — R. Vallery-Radot, *The Life of Pasteur.*

[1] Pneumonia is an inflamed and congested condition of the lung surfaces which is particularly serious on account of its interference with breathing. In cases of recovery it often leaves the lungs in a weakened state favorable to further attacks and to attacks of tuberculosis.

[2] Adami, *Principles of Pathology.*

cause is the attack of one of several varieties of germs that may be present in the lungs. The germs of diphtheria, typhoid fever, tuberculosis, and la grippe are all able to cause pneumonia, as well as some half dozen kinds of so-called pneumonia germs which are more frequently to blame. Since one or more of these germ species are likely to be in the air passages at any time, our main defense against pneumonia is to keep up the general resistance.

**Pneumonia and Alcohol.** — A very large percentage of the cases of pneumonia are traceable to the widespread use of alcoholic beverages. According to Doctor Osler, "alcoholism is perhaps the most potent of all the predisposing causes" of pneumonia.[1] It is also an observed fact that a pneumonia patient who has been addicted to the use of alcohol is much less likely to recover than one of temperate habits. This last effect is due in part to the harmful influence of alcohol upon white corpuscles and in part to its weakening effect upon the heart. Extra work is thrown upon the heart during pneumonia, because of the congested condition of the lungs, and to force the blood through the obstructed capillaries requires sound heart muscle controlled by sound nerves. The weakened heart of the alcoholic usually gives out under the task.

**Specific Resistance.** — Resistance to particular diseases, or specific resistance, is gained most frequently by having the diseases themselves. Immunity is secured through some condition which is developed in the blood and lymph, and it may be in the tissues, which prevents further inhabiting of the body by the germs causing the disease. Although certain of the germ diseases do not confer immunity, and it is possible to have those that do

[1] Osler, *The Principles and Practice of Medicine.*

more than once, the specific resistance obtained in this way has been a tremendous protection to the race. It has also been a fruitful source of suggestion to those engaged upon the problems of preventing and curing disease. One of the outgrowths of such suggestion is the method of prevention, first applied to smallpox, known as vaccination.

**Vaccination.** — Smallpox vaccination was discovered by Jenner in 1796. It consists in subjecting the body to an attack of cowpox germs,[1] a kind of germs quite similar to those of smallpox, but much weaker. Smallpox vaccine is ordinarily obtained by vaccinating healthy calves and collecting the lymph from the resulting sores upon the skin. When these weak germs are introduced through a tiny wound in the skin, they multiply rapidly and soon infest the entire body. Their effect upon the body fluids is similar to that produced by the virulent smallpox germs and they confer an immunity which lasts for several years.[2]

Vaccination has since been applied to several other diseases and with varying success. Next to smallpox the most brilliant results have been in the treatment of the horrible disease known as hydrophobia, or rabies. The Pasteur treatment for rabies consists in the successive vaccinations of the patient with increasingly stronger doses of a vaccine obtained by drying the spinal cords of rabbits to which the disease has been previously communicated.[1] One of the most recent triumphs of medical science, however, has been the prevention of typhoid fever through vaccination.

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[1] Experts are unable to decide whether cowpox is a modified form of smallpox (variola) or is an independent disease natural to cattle. Some firms make an advertising point of the fact that their virus has been brought down direct from outbreaks of cowpox.

[2] No general rule can be laid down as to the length of time which immunity secured through vaccination will last. While it is generally supposed that two or three successful vaccinations are sufficient for a lifetime, it is customary to revaccinate every five or six years if smallpox is at all prevalent.

**Typhoid Vaccination.** — Vaccination against typhoid fever consists in the injection under the skin of a preparation of dead typhoid germs.[2] The vaccine is prepared by growing the germs in large quantities outside of the body, killing them with heat, and adding a little disinfectant to remove danger from other germs. Three injections given ten days apart suffice to give immunity. The procedure is without special danger or inconvenience, no serious results having been noted in the thousands of instances in which it has been used. After the administration a mild reaction may be expected; this consists of a slight swelling and pain at the point of injection, a general feeling of lassitude, and sometimes of headache, and slight fever, which seldom goes over 102° F. As a rule the reaction lasts from six to eight hours and does not interfere with one's usual duties.[3]

Typhoid vaccination has been extensively practiced in the British Army and in both the Army and Navy of the United States. The results leave no doubt as to its effectiveness. Every person entering the United States Army must now be vaccinated against typhoid. As its value becomes more generally appreciated, typhoid vaccination will be extensively used in checking epidemics and in protecting those exposed by travel and other causes. In time it may become the means by which typhoid fever will be entirely eradicated from civilized society.

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[1] Hydrophobia vaccination is recommended when one has been exposed to the disease, as from the bite of an animal having it or from getting its saliva upon an open cut or sore. The germs develop very slowly in the body so that if the treatment is taken promptly the system is prepared to withstand them when they reach the active stage.

[2] Typhoid vaccination was begun in 1896, Wright, Pfeffer, Kolle, and others being credited with pioneer work.

[3] Dr. W. J. Calvert, *University of Missouri Bulletin on Prevention of Typhoid Fever.*

**Precautions in Smallpox Vaccination.** — Before the discovery of vaccination, smallpox was more destructive of human life than tuberculosis is today, but thanks to its employment since the time of Jenner, the disease has been robbed of its former virulence.[1] To preserve this general condition, however, smallpox vaccination must be extensively practiced by each suceeeding generation. This may be done without special danger or hardship, provided the vaccine is administered in a proper manner and the tiny wound, and the sore which develops from it, receives the necessary care. Most of the serious results following smallpox vaccination are traceable to infections from germs other than those of the pure vaccine, and to avoid such infections the following precautions should be observed:

1. The virus should be obtained from a reliable supply house and have the guarantee of government inspection in its preparation.

2. The arm should be thoroughly washed with soap and water, rinsed with water that has been thoroughly boiled, and dried with a perfectly clean towel before the virus is applied.

3. The small wound should be bandaged with sterilized dressings and so kept until the resulting sore is healed.

4. Vaccination should be performed by the physician and if there be undue swelling or soreness this should be looked after by him.

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[1] No fact of medical science is more fully established than the value of smallpox vaccination as a means of prevention. General vaccination is, moreover, our only effective means of stamping out smallpox epidemics.

**Immune Sera.** — When the blood of an animal is allowed to stand in a vessel it undergoes a change (coagulation) by which it forms a solid, called the *clot*, and separates a clear fluid, called the *serum* (Fig. 73). When the serum of an animal artificially immunized against some particular disease is injected into the bodies of human beings, it imparts, in some instances, special defensive properties. This method of curing and preventing disease, the result of Buckner's researches in 1889, seems capable of rather wide application, especially in counteracting the effects of germ toxins. Several of our most dangerous diseases, including diphtheria, tetanus, and cerebro-spinal meningitis, are now treated with immune sera. The general method of preparing these is the same in all cases, though different animals may be employed for the purpose.

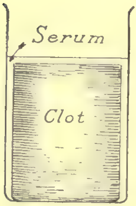

FIG. 73. — **Coagulation of Blood.** One of the processes in the preparation of immune sera.

**Preparation of Diphtheria Antitoxin.** — The preparation of a serum for the treatment of diphtheria includes three general processes, as follows:

1. A strong toxin is prepared by growing diphtheria germs in broth at a temperature of from 35° to 40° C. in an incubator. After a week's growth the germs are killed by the addition of a small amount of carbolic acid and then carefully separated from the solution. The solution which still retains the germ toxins is now carefully tested by injecting measured amounts into a number of guinea pigs. It must be of a strength sufficient for 0.01cc. to kill a guinea pig weighing 250 grams.

2. A small dose of the toxin is now injected into a vigorous young horse (Fig. 74). The first effect is a fever

which lasts from three to five days. After this subsides a slightly larger dose is injected, and after this another. The injections are continued for six weeks or two months, after which the blood of the horse is tested by its effect in counteracting toxins obtained from cultures by the first process. (The test is made by injecting guinea pigs with definite mixtures of the toxin and the blood serum.) If the tests show the blood to be developing sufficient antitoxic properties, i. e., if a certain sized guinea pig keeps well after receiving a standard mixture of the toxin and blood serum, the injections of the toxins into the horse are continued for a month longer. The horse is then ready for the collection of the serum.[1]

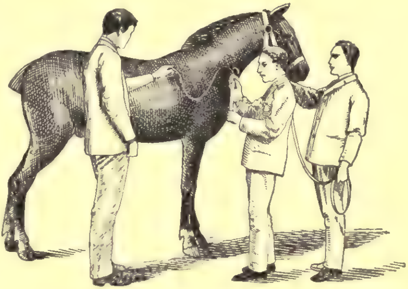

FIG. 74. — **Injecting Toxin into a Vigorous Young Horse** in the preparation of diptheria antitoxin. Only the healthiest animals are suitable for this purpose. (Courtesy of Park, Davis, and Co., Detroit, Mich.)

3. An amount of blood which the horse can easily spare is now taken from the jugular vein, being transferred by a sterile rubber tube to a clean glass vessel. After the blood has thoroughly clotted, the process requiring about four days, the serum is withdrawn from the clotting receptacle and stored in large vessels in a refrigerator. From this the small vials are filled which are sent out to physicians.[2] In every stage of the clotting, storing,

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[1] If the tests show that the horse is not likely to develop an antitoxin of sufficient strength, the injections are stopped and the animal sold.

[2] For the physician to use diphtheria antitoxin with any degree of accuracy it must be standardized. The unit of standardization is defined as

and distributing, the greatest care is exercised so that the serum does not become contaminated with outside germs and that it gets to the diphtheria patient in a perfectly sterile condition.

**How Diphtheria Antitoxin Cures.** — Although the immune sera act in different ways as aids to the body in combating the effects of germs, the antitoxic method seems to be the most important and best understood. This is explained in the diphtheria treatment as follows: When injected into the patient, the diphtheria antitoxin neither destroys germs nor aids in the recovery of cells that have been injured by them. It acts, as its name implies, as a counteractive of poison — the poison produced by the germs. It is the germ poisons or toxins that render diphtheria so dangerous, and their action is upon the nervous system. Hence when their effects are counteracted by the antitoxin of the serum, the essential condition for recovery is supplied.

**Summary.** — All of our so-called infectious diseases are caused by micro-organisms, or germs, which have become adapted to living within or upon the body. Whether sick or well we are in continual conflict with these germs, waging a warfare which is both defensive and offensive in its nature. The present chapter deals with defensive measures — measures whose purpose is to supplement and strengthen the natural defenses of the body. They include the use of germicides upon skin wounds, the sterilization of solid foods, milk, and water by heat, the strengthening by suitable means of the surfaces of the food canal and the air passages, the destruction of germ colonies in all parts of the body, and the

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"ten times the amount of antitoxic serum necessary to just protect a 250 gram guinea pig against ten fatal doses of toxin."— Bolduan, *Immune Sera.*

maintenance of an effective resistance which may be general or specific. When applied in conjunction with offensive methods, as explained in the chapter following, they provide ample protection against our invisible enemies, the germs of disease.

**Exercises.** — 1. How do disease germs differ from micro-organisms in general? In what ways do they harm the body?

2. How do defensive differ from offensive methods of warfare? Outline the general plan by which the body defends itself against germs.

3. Explain the necessity for the use of mild germicides upon skin wounds. Under what circumstances is radical treatment of skin wounds necessary?

4. How do the germs of tetanus and of hydrophobia find entrance into the body? Why must all cases of possible infection by these germs be reported to the physician?

5. What conditions favor the entrance of germs through the food canal? What fundamental precautions do these suggest?

6. In what ways do indigestion and constipation predispose one to germ attacks within the food canal?

7. State the causes of appendicitis. How may this disease to a large extent be avoided?

8. In what different ways do the nostrils keep germs from reaching the lower air passages? Enumerate the advantages of nose breathing.

9. What minor surgical operations must frequently be performed upon the nose and throat? What harm results if these operations are avoided?

10. What are germ colonies? In what ways are they a menace to the health? How are they removed from the upper air passages?

11. How may one increase the resistance of his lung and throat surfaces?

12. Explain the outdoor cure for tuberculosis. What phases of this cure are applicable to lungs that are weak but not diseased?

13. How does general differ from specific resistance? Upon what does general resistance chiefly depend?

14. How is the general resistance kept up?

15. Show that avoidance of pneumonia depends chiefly upon general resistance. Why does the use of alcohol predispose one to attacks of pneumonia? How does it hinder recovery?

16. In what different ways is specific resistance obtained?

17. What are vaccines? How prepared? How do they confer immunity?

18. What precautions should be taken in smallpox vaccination? Why? Under what conditions is vaccination against hydrophobia necessary?

19. Describe the method of procedure in typhoid vaccination. Why is typhoid vaccination of special value in the army? Show that it has corresponding advantages in everyday life.

20. What are immune sera? Why so called? Explain the general mode of their action.

21. What is an antitoxin? Account for the name. How is diphtheria antitoxin prepared?

22. Summarize the general methods of defensive warfare with germs.

## Health Work

In ordinary warfare a selected and highly trained body of men fight the battles for the whole nation, and the nation wins or loses through its soldiers. This method is applicable only in part to our warfare with germs. The germ fight, in so far as defensive efforts are concerned, is largely an individual fight. Although we may help each other in important ways, *each one must himself defend his body fortress.* For this reason he should guard all points of possible attack.

He should see that skin wounds, large and small, do not become infected.

He should drink pure water. If this cannot be obtained, he must use water that has been boiled.

He should avoid all kinds of raw food, including milk, unless quite sure that it is free from harmful germs.

He must so control his eating and his processes of digestion that chemical and mechanical irritations do not pave the way for germ entrance through the food canal.

He must breathe through the nostrils.

He must fortify his body against colds and prevent the establishment of germ colonies in the upper air passages.

He must look after all the conditions that make for good general resistance and avoid the indiscretions that bring this down even for short intervals.

**Fighting the Tendency to Colds.** — One bad effect of colds is to weaken the respiratory surfaces and, by so doing, prepare the way for germs of tuberculosis. The germs of tuberculosis are too weak to fasten themselves upon healthy lung surfaces, but depend upon conditions established by other germs. The germs of colds and of grip, as well as those of pneumonia, may supply just the condition which tuberculosis in its beginning requires. Hence to fight the tendency to take cold is to build up strong resistance against this most serious of lung diseases.

If one has put into practice the suggestions on page 113 and continues to take cold easily, it means that the causes have not all been removed. A lingering cause is often found in a catarrhal condition of the nose or throat. A catarrhal surface is one in a chronic state of congestion and usually one inhabited by germs. On this account only slight chilling of the skin is necessary to cause the greater congestion which gives the cold germs the start they need. One taking cold easily on account of catarrh should be most diligent in securing a suitable remedy, not omitting medical aid.[1]

**Fighting Tuberculosis of the Lungs.** — There has been found so far no medicine that can cure consumption. The forces of the body, however, if properly directed upon this enemy before it becomes too deeply entrenched, can overcome it. If the symptoms of the disease (page 400) are present, one should apply at once to a reliable physician for a thorough examination, including a microscopic test of the sputum. (Failure to find tuberculosis germs, however, should never be taken as sufficient proof that the disease is absent.) In order that all possible preparations be made for the impending conflict, it is necessary that one know the exact truth. With the advice and aid of the physician the following conditions should be supplied as fully as possible:

1. The nervous energy should be carefully conserved. It is highly necessary that the force that may be lost through eyestrain, worry, study, or some other form of nerve leak, be used in building up health.

2. The army of white corpuscles must be concentrated upon the germs of tuberculosis. This is accomplished by ridding the body of all other infections. Especially should catarrh, sore throat, and infections of the skin be cured.

3. The body must be subjected constantly to the action of outdoor air. Not only must the day be spent in the open, but one must sleep out of doors, taking suitable precautions against bad weather. *Fight constantly any tendency to take cold.*

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[1] A vaccine for the prevention of certain forms of cold is now used by physicians with good results in individual cases. Vaccination should certainly be tried by one having weak lungs who cannot otherwise prevent the frequent occurrence of colds.

4. The habit of full breathing must be established. Avoiding the occasional effort to fully distend the lungs, put a little extra effort into each breath. The exercise itself is helpful as well as the admission of more oxygen to the lungs.

5. A vigorous condition of the entire digestive system should be maintained. The consumptive should eat freely of nutritious food, but should avoid overeating and the use of substances that give trouble in digesting.

6. Moderate daily exercise should be taken provided there be no fever. When fever is present the exercise should be omitted.

7. Avoid spitting upon walks or floors, since this method of disposing of the sputum may infect others and reinfect the patient. Also avoid swallowing the sputum, as this often infects the intestines. Use cloths or paper for collecting the sputum, being sure that these are burned or disinfected daily.

Although one should never attempt to fight this great battle without the physician's aid, he must not make the mistake of depending too much upon the physician. The patient can do vastly more for himself than anyone can do for him and upon his own efforts and upon his courage and determination victory largely depends.

## CHAPTER XVII

## GERM FIGHTING: OFFENSIVE METHODS

"If we cannot make peace with our enemies, we must fight and fight to win."— *Anon.*

HAVING considered the defensive methods of germ warfare, we now turn to the offensive methods. These are based largely upon our knowledge of the life habits of the minute organisms causing disease.

**Germ Habits.** — Each of the species of micro-organisms is able to live and propagate its kind by virtue of some existing condition to which its mode of life corresponds. In the development of the individual germ, moreover, it must pass through definite stages which occur in regular sequence, as do the larger plants and animals with which we are familiar. As stated in the preceding chapter, most of the germs that cause disease are adapted in their habits to conditions supplied by human beings — living in or upon the body and being passed from one to another by some agency associated with people. As we become acquainted with the habits and mode of life of the different kinds of disease germs, we can usually find some means of destroying them or of preventing their development.

**The Method of Interception.** — Disease is propagated by the passage of germs from the person in whom they may be present[1] to the bodies of others. Unless this occurs, the disease is held in its source and soon ceases to exist.

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[1] In a very few instances, as tuberculosis in cattle, disease germs come from sources outside the human body.

At the time of the passage, moreover, the germs are entirely outside the body, so that the most drastic measures may be employed in their destruction. For these reasons, interception of the germ passage is our most important offensive method in fighting disease. By varying its application to existing conditions, epidemics may be checked and in some instances germ species wiped out of existence. We shall first consider its application to diseases whose germs are spread by means of insects and vermin.

**Malaria and Mosquitoes.** — Malaria, or malarial fever, is caused by animal germs (protozoa) which attack and destroy the red corpuscles of the blood. These germs are passed from malarial patients to others through the agency of mosquitoes — a genus known as *Anopheles.* If mosquitoes belonging to this genus suck the blood from malarial patients, they first infect their own bodies, after which they inject the germs under the skin of whomsoever they feed upon. The germs, moreover, pass through an important stage of their development while in the mosquito, so that when introduced into the human body they are in a state to do harm. The most effective method of fighting malaria, therefore, is to fight mosquitoes. We must either do away with mosquitoes entirely or so reduce their numbers that they cease to be a menace.

**Methods of Mosquito Destruction.** — The more effective methods of reducing the mosquito pest are the following:

1. Drainage of bodies of water in which the mosquitoes lay their eggs and in which the larvæ develop.

2. Covering with crude oil or kerosene bodies of water that cannot be conveniently drained. The thin layer of oil on the surface destroys the larvæ by keeping them from getting oxygen. Both in draining and oiling, the pro-

tected pools, such as the rain barrel, the open cistern, tin cans and other receptacles in the rubbish heap, and vaults and small low places need special attention. These are better adapted to the breeding of mosquitoes than the larger bodies in which there are currents and waves.

3. Stocking bodies of water too large for draining or for oiling, with suitable varieties of fish. While most fish are voracious feeders upon mosquito larvæ, the fresh water perch, or sun fish, are especially valuable for this purpose. If streams and lakes are kept free from weeds and well supplied with fish, mosquito larvæ cannot thrive.

While these methods are being applied, the greatest precaution should be taken to prevent both well and sick from being bitten by mosquitoes (page 35). This includes the thorough screening of all places where the sick are cared for and where the well sleep or rest.

**Other Dangers from Mosquitoes.** — Although but one kind of mosquito is known to be instrumental in the transmission of malaria, there are other dangers associated with these insects, and these are such that all kinds of mosquitoes must be looked upon as enemies of man. Yellow fever of the tropics is spread by mosquitoes — a species known as *Aedes calopus*[1] — and there is some evidence that even our supposedly harmless mosquito (*Culex*) is responsible for the transmission of two tropical diseases affecting the blood, known as dengue and filaria. The blood-sucking habit of mosquitoes is, moreover, a source of nervous irritation, and in some districts the loss of blood may be such as to materially weaken the body. In addition to this, every tiny wound is an avenue through which the skin may become infected. For these reasons the war against mosquitoes should not be limited to particular species, if this were possible, but should be directed against the family as a whole.

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[1] Formerly known as *Stegomyia calopus*.

**Bubonic Plague[1] and its Spread by Rats.** — This disease, frequently referred to as the plague, is widely prevalent in tropical countries. It is a disease of the lower animals as well as of man, members of the rodent order, to which belong our familiar rats and squirrels, being most frequently attacked. Rats are known to develop a chronic form of the disease, and to this source most of our recent outbreaks have been attributed. From the rats (in a few instances from ground squirrels) the germs are transmitted to man by means of fleas which live upon the rodents. The fleas become infected by biting the diseased animals, after which they communicate the disease by biting people. The effective method of combating plague is that of exterminating the dangerous rodents, especially rats. This does away with the host in which the germs develop and also the fleas that transmit the germs to man.

Although bubonic plague is classed as a tropical disease, all of our seaport cities which have commercial relations with the tropics are liable to epidemics. The outbreaks that have already occurred should serve as warnings against at least one serious danger that may result from the development of droves of rats in crowded cities.

**Sleeping Sickness and the Tsetse Fly.** — This deadly disease, which attacks the blood primarily and which is recognized by a stupor resembling sleep, is widely prevalent in the African Continent and is spread by an insect common to those regions, known as the tsetse fly. The tsetse fly first becomes infected by biting those sick with the disease, after which it communicates the germs by biting those who are well. As in other diseases to be mentioned later, sleeping sickness is not dependent upon a single agency for its transmission, and as a consequence cannot be entirely prevented by the destruction of the fly. Further difficulty is encountered in its prevention by the fact that it prevails among certain of the lower animals, notably dogs and monkeys.

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[1] So named on account of great swellings of the lymphatic glands in the armpits and groins, called buboes. Human beings do not become sources of infection unless the swellings break or the disease attacks the lungs.

**Rocky Mountain Spotted Fever and Ticks.** — This dangerous disease, which is characterized by a high fever and by red spotted eruptions, prevails to some extent in several of the Rocky Mountain states. A recent careful study of the disease in which one investigator, Dr. T. B. McClintoc lost his life, has shown it to be transmitted by a species of ticks that lives upon the small wild animals of those regions. The germs pass through an important stage of their development while in the ticks and may even be communicated to their offspring. Efforts to eradicate this disease by measures directed against animals harboring the ticks have proved successful.

**The House Fly, a Germ Carrier.** — An important agency in the spread of several diseases is now recognized in the common house fly. Since the germs undergo no special change while associated with the fly, as do the malarial germs in the mosquito, it is referred to as a *mechanical carrier* to distinguish it from the so-called *biological carriers* in which the germs pass through a stage of their development. The chief rôle played by the fly is in the transmission of germs associated with filth, especially with discharges from the body, this resulting from its habit of feeding upon all kinds of waste, as well as upon the food served at the table. It thus transfers the germs contained in sputum, in the pus from running sores, and in the discharges from the bowels and the kidneys, by either or both of two methods — by collecting germs upon its mouth parts and feet and depositing them later upon food supplies, and by carrying them in its food canal with the filth which it has eaten. The germs pass through the fly without being destroyed and are to be found alive and active in the familiar "specks." At least four dangerous diseases — typhoid fever, tuberculosis, cholera, and the summer diarrhea of children — are spread to some extent by the house fly. Although authorities do not agree upon the results in disease prevention that would follow the complete destruction of flies, there is abundant evidence that this is a most desirable sanitary measure for every community (Fig. 75).

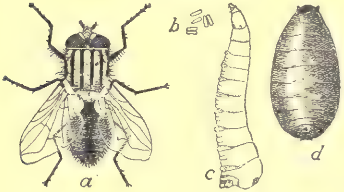

FIG. 75. — **Life Cycle of the Common House Fly.** *a.* Adult. *b.* Eggs. *c.* The larva or grub stage. *d.* The pupa. Flies are easily destroyed in any of their stages of development.

**Why the House Fly Should be Exterminated.** — Flies are a source of annoyance and irritation and serve no useful purpose. They render more difficult the problem of household cleanliness. Their presence in a home is evidence of poor sanitary conditions generally and of low standards of living. They are a positive menace to health. For this last reason flies should not be looked upon simply as intruders upon the comfort of the home, but as enemies fully as dangerous as the poisonous reptiles which in some instances find shelter in houses. Methods of destroying flies are considered in the chapter following.

**Other Modes of Conveying Infection.** — While the living carrier is the most dangerous of the agencies for the transmission of germs, it is by no means the only one. The germs of several diseases are spread by direct contact of one person with another. Food and water are easily contaminated in a number of ways, as already suggested, and are a chief means of introducing germs through the food canal. Certain diseases are said to be "air borne" on account of their being spread, under certain conditions, through atmospheric movements. And in all the exchanges of material substances in civilized society we are in constant danger of exchanging the germs of disease. These different methods of transmission suggest corresponding methods of interception, all of which find practical application in the prevention of our more common diseases.

**The Spreading of Typhoid Fever.** — In this disease, now recognized as a general infection (see footnote, page 324), the germs first attack the lining of the small intestine and later spread through the blood to all parts of the body. As the germs develop in the patient they appear in immense numbers in the discharges from the bowels and the kidneys. Although they are occasionally found in the secretions from the mouth and the air passages, and sometimes in the vomit, their regular mode of leaving the body is through the feces and the urine. The germs contained in these, if not destroyed by disinfectants, may find their way into the food canals of people by a number of means, water being the chief agency in the transfer. When thrown upon the ground, into shallow privy vaults, or into sewerage systems that empty into streams, they easily drain into bodies of water used for drinking purposes or, as in the contamination of oysters (page 146), may become attached to our solid foods. Water from shallow wells and improperly constructed cisterns, and from springs, basins, and lakes, may, on account of surface drainage, contain typhoid fever germs. Water from running streams is dangerous both on account of surface drainage and sewerage contamination. Water presenting evidence of contamination (page 368) in the way of color, odor, taste, or the source of its supply, should not only be thoroughly boiled before drinking but also before being used for cleansing articles, such as milk pails and bottles, that are used in connection with foods.

**Other Agencies in the Spread of Typhoid.** — The water route is by no means the only agency for the transfer of germs from typhoid fever patients to those in health. Nurses, by letting their hands get ever so slightly soiled, may transfer germs to food for the table. By this and other means the milkman who has typhoid fever in his family or who, having had the disease himself still passes the germs from his food canal, may infect the milk supplied to his customers. The house fly, by the methods stated above, is a most important carrier of typhoid germs. Flies are responsible, in some instances, for the infection of milk by their obtrusion upon the pails and bottles used in its collection and transportation. It is also true that any insect or lower animal form that comes in contact with typhoid excreta and later with food materials may play the same rôle of mechanical carrier as the fly.

**Typhoid Carriers.** — A discouraging feature relative to the fight against typhoid fever, and accounting in part for its great prevalence, is the fact now definitely established that many people who seem to have entirely recovered from the disease,[1] still produce the germs in an infected gall-bladder and pass them from their intestines. Statistics show a considerable number of cases in which this has continued for years after the patient has been discharged by the physician. Typhoid carriers also include those who have the disease in such a mild form that they are not recognized as typhoid cases at all, and as a consequence do not have their habits regulated. It is estimated that more than half of all the cases of typhoid fever are due to germs derived from carriers. To control this source of infection legal enactments which require expert examination of the feces of those recovering from the disease and which regulate of the habits of such as are found to be carriers, are necessary.

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[1] Authorities vary from two to seven per cent in their estimates of the chronic carriers, or those who continue to have the germs for more than ten weeks after recovery from the disease. Up to this time every convalescent typhoid patient is likely to harbor the germs and should, on this account, so dispose of his discharges as not to endanger the lives of others.

**Summary of the Methods of Fighting Typhoid.** — The different ways by which typhoid fever germs are able to pass from one person to another require that not one but many methods of prevention be employed. These include:

1. The thorough disinfection of discharges from the bowels and kidneys of typhoid patients and the sanitary disposal of such discharges from people in general (Chapter XVIII).
2. The complete destruction of house flies.
3. The constant use of thoroughly cooked food and of pure or boiled water.
4. The enactment of laws which require expert examination of the feces of those who have had typhoid fever and which regulate the habits of such as are found to be carriers.
5. The wide general use of typhoid vaccination (page 338).

**The Spreading of Tuberculosis of the Lungs.** — Tuberculosis of the lungs, commonly known as consumption, is caused by the attack of a well-defined species of germs (*tuberculosis bacilli*) upon these organs. The disease results in much coughing and expectoration, and every mouthful of material brought up contains tens of thousands of living germs. Some of the more important ways by which these are spread to new victims[1] are as follows:

1. By coughing with the mouth uncovered (page 371).
2. By the habit of untrained consumptives of spitting upon the floor, the walk, or the ground. The sputum soon dries and is ground into dust, but without killing the germs. When such dust is breathed the germs are again moistened and warmed into activity.
3. By the act of kissing.
4. By means of flies, as already described.
5. By the use by others without sterilization of towels, handkerchiefs, pencils, toys, drinking cups, etc., previously used by consumptives.

**General Precautions.** — The sputum of consumptives should always be deposited upon cloths, in paper cups, or in vessels containing a disinfecting fluid, and should never be deposited in such a manner as to permit it to dry out. The patient must have his private drinking cup, and any object touching his lips must not be used by others without first being thoroughly scalded. He should have a room to himself, preferably a screened room, open on three sides and without artificial heat, body heat being conserved by heavy clothing and hot water bottles, and he should sleep alone. The utmost care should also be exercised in the cleaning and disinfection of clothing, furniture, and bedding used in connection with the patient, and to the disinfection and fumigation of rooms and dwellings occupied by consumptives before they are again inhabited by others.

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[1] Upon the question of tubercular cattle being a source of human infection, the investigations of Ravenel and others leave no room for doubt. *People do contract tuberculosis from cattle.* The number contracting the disease by this means, however, appears not to be so great as at one time supposed. — See Chapin's *Sources and Modes of Infection.*

To avoid infection from tuberculous cattle, animals shown by the *tuberculin test* to have the disease, must be eliminated from the dairy herds. This test is made by injecting under the skin, a solution prepared from dead tuberculosis germs. If no fever follows the injection, the animal is considered free from the disease. Tuberculin is also used to some extent in diagnosing tuberculosis in human beings. The preparation was originally developed by Koch as a means of treating the disease itself.

The consumptive must himself realize the importance of care in the disposal of his sputum, both for his own sake and for the protection of others. He should cough as little as possible (coughing which brings up nothing is harmful) and in so doing should keep the mouth covered; in no instance should he swallow the sputum (page 346). He should also be cautioned against the kissing and fondling of children and against putting anything to his lips that may later come in contact with the lips of others without being first sterilized. Although it is usually better for all concerned that the patient be sent for treatment to a well-equipped sanatorium, home treatment under the direction of a competent physician which provides rest, outdoor living, and a nutritious diet, may be fully as effective (page 345).

**Spreading of Diphtheria.** — Diphtheria, including "membranous croup" (page 403), is caused by germ attacks upon the membranes of the throat. The germs causing diphtheria are spread chiefly by discharges from the mouth and throat, and to such discharges especial care must be given. They must be collected on cloths and burned or rendered harmless through disinfection. Objects brought in contact with the lips, such as cups, toys, pencils, and eating utensils, must be thoroughly sterilized before they are used by others. Special danger arises in diphtheria, as in typhoid fever, from those who are apparently well. Children have diphtheria germs in the mouth for some time after they have recovered from the disease and are sure to spread them if permitted to attend school or to play with other children. There are also cases so mild that they appear to have only colds, but such are as dangerous in spreading germs as those having the disease in a severe form.

The time of returning to school after recovery from diphtheria must be determined by the physician after microscopic examination of the discharges from the throat.[1] It is also well for the teacher to insist, during outbreaks of the disease, upon medical examination of all children afflicted with severe colds.

**The Spreading of Eruptive Diseases.** — Scarlet fever, measles, chicken pox, and smallpox, on account of the skin eruptions which attend them, are classed as eruptive diseases. As the eruptions heal, scales separate from the skin, and these were formerly supposed to be the chief means of spreading the diseases. It is now known that discharges from the mouth, throat, nose, and eyes are the more important sources of contagion, except in the case of smallpox, which has for its chief mode of transmission the material separating from the skin. In all of these diseases, especially smallpox, attention must be given to the destruction of material from the skin, and all objects, such as clothing and bedding, that have been in contact with the patient should be thoroughly disinfected or burned. Smallpox sores should have antiseptic treatment, and in scarlet fever it is well to rub the body of the patient with a soft cloth covered with carbolated vaseline in order to collect and disinfect the separating scales.

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[1] The law in many states requires that children be kept out of school until two negative cultures have been obtained in a bacteriological laboratory.

**The Spreading of Meningitis.** — Cerebral and spinal meningitis are caused by attacks upon the lining membranes (*meninges*) of the brain and spinal cord of germs which first find lodging places upon the membranes of the nostrils and throat. While many people have these germs upon their mucous surfaces, it is only in a comparatively few cases that the germs penetrate to the deeper parts. Danger arises from the large number of people who are spreading meningitis germs from the colonies of these which they harbor in their noses or throats. To prevent the spread of meningitis the coöperation of the entire community is necessary to the end that no one may permit himself to act as a carrier. This is accomplished, during the prevalence of epidemics, by the daily cleansing by everybody of the nose and throat surfaces with some mild antiseptic solution, best prescribed by the physician. In complying with such a regulation one is working for self, as well as for the general good, since the treatment prevents the development of individual cases. Children and young people, being more susceptible to the disease, should, during epidemics, avoid public gatherings and carefully guard the general health. Prolonged chilling seems to be a predisposing cause, having the effect apparently of lowering both the local and general resistance (page 334).

**The Hookworm Disease.** — Although hookworms are not germs, the mode of their passage from one victim to another is quite similar to germ transmission, and the disease itself is supposed to be due as much to the injection of toxins as to the withdrawal of blood by these parasites. The worms (Fig. 76) causing the disease find their natural habitat in the human intestine, where, by attaching themselves to the membranous walls, they suck the body fluids. About their only other function is apparently that of producing eggs, which, unable to hatch within the intestine from lack of oxygen, are passed out with the feces. Moist soil supplies a suitable hatching place for the eggs and for the first stage of development. The tiny worms then get into the body through the skin of the feet of barefoot children and of adults with leaky shoes. The so-called "toe itch" and "dew itch" of our Southern states has been shown to be the result of such attacks upon the feet. From the skin they enter the blood, and from the blood they find their way to the food canal, supposedly by penetrating the thin walls of the lungs and passing up the air tubes to the pharynx, from whence they are swallowed with the food. Now that the disease is understood, its cure and prevention present no serious difficulties. The worms are easily dislodged from the food canal by medicinal remedies, while prevention is accomplished by properly disposing of intestinal waste (page 391) and adequately protecting the feet.[1] The hookworm disease is widely prevalent in tropical and sub-tropical countries — all places, in fact, where severe winters are absent.

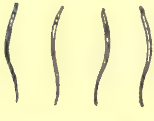

FIG. 76. — **Hook Worms.** Actual size.

**The Spreading of Gonorrhea and Syphilis.** — These dangerous and loathsome[2] diseases are spread by germs which readily penetrate mucous surfaces and which also enter the body by open sores and tiny skin wounds. Because their usual mode of transmission is through the sinful indulgence of the animal passions, there has been a strong tendency to omit any reference to them in courses in school hygiene. It must always be a purpose of science, however, to reveal the truth and to give warnings where warnings are needed. There are no greater dangers to public and individual health than lurk in the causes, direct and indirect, that lead to the transmission of these diseases. The germs of both remain in the body and are communicable for long periods after apparent recovery, a fact which accounts for their ravages among innocent victims in the home. Effective warfare is waged against gonorrhea and syphilis through the elevation of moral and social standards, through the wider teaching of purity of thought and conduct, and through the prohibition by law of the social evil in its commercialized forms (page 416).

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[1] Second in importance only to the prevention of yellow fever and malaria by the destruction of mosquitoes, has been the discovery of the nature and cause of the hookworm disease and of methods of preventing and curing it. In sections of our Southern states and in Porto Rico the results in health improvement following hookworm campaigns have been most wonderful.

[2] Syphilis is the most dangerous and far-reaching in its effects of all diseases, not excepting tuberculosis. It is highly contagious and is frequently spread by other than the usual mode of transmission. It affects the entire

**Isolation of Patients.** — The removal of people sick with infectious diseases from those who are well has long been recognized as an effective means of checking epidemics. The principle, moreover, is applicable to all kinds of contagious diseases. Distance presents a barrier which the

body, one of its manifestations being open sores which may occur anywhere upon the skin. Mucous surfaces are more often attacked, and sores on the lips are frequently the means of communicating the disease, as may be done by kissing and the common use of drinking cups, pipes, etc. Its blighting effects are hereditary, and children born of syphilitic parents are so puny that not over thirty per cent of them live to maturity.

Gonorrhea is but slightly less destructive in its effects than syphilis. It may injure in its complications the muscles, joints, and vital organs. One serious complication is an acute inflammation of the eyes which may result in partial or complete blindness. Most children supposed to have been born blind, have in reality lost their sight through gonorrheal infection at birth. Gonorrhea is a chief cause of barrenness and frequently necessitates, in women, surgical operations for the relief of the complications which arise.

germs cannot pass, except through the intervention of carriers, and these must of course be excluded. Objection is frequently made to isolation, or quarantining, on the ground that it works hardship upon the patients and those having them in charge, and this objection is in some instances well founded. Since the chief purpose of isolation is the protection of the community, ample provisions should be made for the patients at public expense when it is deemed necessary to remove them from their homes.

Room isolation should be practiced in all cases where patients with contagious diseases are kept in the home. Germs cannot penetrate solid walls. Hence if the doors and the cracks around the doors are kept completely closed and the usual precautions observed by those attending the patients, the other inmates of the house can be protected.

**Agencies for the Destruction of Germs.** — Of no less importance to the germ fighter than are arms and ammunition to the soldier, are the agencies which he may use for the destruction of germs. These include:

1. *Heat.* Germs are easily destroyed by heat, most of them being killed by a boiling temperature. To thoroughly boil infected articles, clothing, or foods in water is to destroy their germs. Dry heat and steam are also effective. Burning is usually the best method of destroying the germs contained in rubbish and household articles of little value (Fig. 77).

2. *Drying.* Drying checks the growth of all germs and thorough drying kills most of the germs which cause disease. Dampness, on the other hand, tends to keep them alive. To avoid dampness is of special importance in the home. Rooms which, by sunning and airing, are kept thoroughly dry do not serve as harboring places for germs.

3. *Light*, especially direct sunlight, is an important destroyer of germs.

4. Several kinds of *chemical agents*, referred to as disinfectants and germicides (germ killers) are extensively used in destroying germs. These are especially valuable in disinfecting discharges from the body, in destroying germs upon the hands or the person generally, and in the final clean-up of the home following convalescence from some infectious disease. Some of the more important of these require special mention.

FIG. 77. — **Fire Destroys Germs.** One of the first known of the methods of preventing the spread of disease, burning is still the best way of disposing of many kinds of infectious material.

**Valuable Germicides.** — Germicides which may be used about the home, provided one exercises care in their storage and use, include the following:

1. Bichloride of mercury, or corrosive sublimate. This is used in strengths of one-half drachm (30 grains) to one gallon of water. It is especially valuable for disinfecting the hands and for washing

woodwork. It is destructive to metals, and for this reason should be kept in and used from glass, porcelain, or wooden vessels. It is highly poisonous and is suitable only for external use.

2. Carbolic acid is a valuable and much-used disinfectant. A five per cent solution (six ounces to a gallon of water) is used for disinfecting sputum and other excreta. A solution of half this strength may be used on the hands and for disinfecting clothing, linens, and bedding. (Clothing, etc., should be placed in the disinfecting solution before removing from the sick-room.)

3. Chloride of lime, or bleaching powder. A solution prepared by adding five ounces to a gallon of water is valuable for disinfecting excreta, privy vaults, cesspools, etc. On account of its bleaching action, it cannot be used on most clothing. Only the fresh powder or that from tightly sealed packages is of value, and solutions should only be made up as needed. This is said to be the best disinfectant for use in typhoid fever.

4. Milk of lime. This is a valuable disinfectant for the body wastes and is perhaps the cheapest to be obtained. To make the solution, add one part by weight of *freshly slacked* lime to four parts of water and stir the whole until it has the appearance of milk. Only fresh lime should be used; that exposed to the air for some time loses its strength and is worthless. It should not be emptied into sinks, as the solid particles will clog the pipes.

5. Formaldehyde, or formalin. This may be used in solutions (six ounces of the forty per cent solution to one gallon of water) for the same purposes as carbolic acid, although it is somewhat injurious to the hands. Its more frequent use, however, is for fumigation, as explained in the section on Health Work.

6. Several preparations from coal tar containing cresol — lysol, chloro-naphthalene, cresoline, etc.— are disinfectants of recognized merit and are said to be more powerful and safe in their use than carbolic acid. They are used in solutions varying in strength from one-half of one per cent to three per cent for all the purposes mentioned above. Complete directions are supplied by the manufacturers.

All of these disinfectants except the milk of lime are poisonous and should be so labeled. They should for obvious reasons be kept away from substances used as food or medicine.

**Disease Reservoirs.** — Although offensive warfare against the germs of disease finds its most important method of attack in the means by which germs are kept from passing from one person to another, complete success in disease prevention cannot be attained through this method alone. Ultimate victory depends upon our finding out and doing away with the harboring places of germs during the periods when there are no outbreaks of disease. Though lacking in our knowledge of such harboring places, or reservoirs, it is known that some such place or condition exists for the germs of each of the infectious diseases. We already have a clue to possible typhoid reservoirs in the typhoid carriers (page 354), to malarial reservoirs in the continued existence of germs in the blood of convalescent malarial patients, to tuberculosis reservoirs in the prevalence of this disease among cattle, and to plague reservoirs in the prevalence of plague among rats. Germs are also known to exist in an inactive state in clothing, in the furniture, fixtures, and walls of rooms, and in soils, and to remain so for rather long periods of time. As our knowledge in this field increases we may hope to destroy the more important of the germ species causing disease.

**Summary.** — The war with infectious diseases has been in progress since the advent of man. Until recent years, however, he has been fighting on the defensive and at a great disadvantage. But he has been slowly learning the habits of disease-producing organisms — the conditions under which they propagate their kind and their modes of attack — and this knowledge is enabling him to fight on the offensive; to attack his enemies as well as to repel their attacks upon him. Offensive warfare against disease has for its chief method the interception of germs as they pass from the sick to the well — a method capable of the widest application and one which is exceedingly effective. By killing germs as they leave the body, by destroying insects and vermin which serve as carriers, and by a wide use of the natural agencies which prevent the development of germs outside the body, results are now being accomplished which were formerly impossible. Further suggestions on germ fighting are found in the two chapters following.

**Exercises.** — 1. State the importance of a knowledge of the life habits of disease germs. Explain the general method of interception.

2. Explain the method of transmission of malarial germs. Why is mosquito destruction the most important means of prevention?

3. Enumerate the different means of preventing the development of mosquitoes. Why should the entire mosquito family be exterminated?

4. How are rats and fleas responsible for the bubonic plague? How does the destruction of the rats do away with the disease?

5. Explain the method of transmission of sleeping sickness. Of Rocky Mountain spotted fever.

6. How does a biological differ from a mechanical carrier? In what different ways does the house fly transmit the germs of disease?

7. Why should the house fly be completely exterminated?

8. Enumerate the different means by which typhoid fever germs are passed from the sick to the well.

9. Define a "typhoid carrier." Why are typhoid carriers more dangerous than people sick with the disease?

10. What advantages has vaccination over the other methods of preventing typhoid fever?

11. What is the chief source of infection in tuberculosis of the lungs? What precautions should be observed on this account?

12. State the advantages to the patient and others of detecting tuberculosis in its early stages.

13. Give directions for the proper management of a case of tuberculosis in the home.

14. Through what means are the germs of diphtheria spread among children? Who are diphtheria carriers? How is danger from carriers to be avoided?

15. What are eruptive diseases? By what different means are the germs causing them spread to new victims?

16. What precautions are necessary during outbreaks of meningitis? Why?

17. State the nature of hookworm disease and the method of its propagation. What general precautions should be observed in hookworm districts?

18. State the purpose of quarantining. How is room isolation of the patient made effective?

19. Enumerate the general agencies for the destruction of disease germs. State the special use of each.

20. What are disease reservoirs? How do these render more difficult the problem of prevention?

### Health Work

While the defensive methods of germ warfare must be applied individually — each one fighting largely for himself — the offensive methods enable one person to fight for others; to accomplish-results sometimes that benefit an entire community. The aim, however, is not to place a burden upon anyone, but to have each person do his part in the establishment of conditions for the general good, somewhat as in the application of the Golden Rule to daily conduct. Indeed a phase of this work may be appropriately referred to as

**The Golden Rule of Hygiene.** — The fact that everyone may at times be a producer and distributer of germs makes him responsible, in a large measure, for the health of others. He should feel this responsibility and govern his actions accordingly. *As we would that others protect us from their germs, so should we protect them from our germs.* In addition to the broad application of this principle there are certain special applications which deserve mention:

1. People recovering from typhoid fever should for a year or more exercise the greatest care in disposing of the discharges from the bowels, unless convinced by a microscopic examination by an expert that they no longer produce typhoid germs.

2. Consumptives should employ approved methods for preventing the spread of germs from the mouth as explained in the text.

3. Children recovering from diphtheria and other contagious diseases should not return to school until pronounced safe by the physician.

4. People with severe colds should keep away from crowded places and should avoid talking and laughing "in the faces" of others.

5. Adults should refrain from kissing infants and small children.

6. Those producing or handling food products — meats, milk, etc.— should protect these from the usual sources of contamination.

7. As soon as any contagious disease is discovered in the home a placard bearing the name of the disease should be posted at the front entrance and people warned generally of the danger.

**To Rid the Home of Germs.** — Following a case of infectious disease, the floors should be scrubbed with a strong solution of soap in water, the woodwork should be similarly cleaned or repainted, and the walls repapered or calcimined. All clothing, bedding, and furniture used in connection with the patient should either be sterilized or burned. For destroying germs adhering to the walls, furniture, and clothing, fumigation is frequently employed, and for this purpose a forty per cent solution of formaldehyde is the best known substance. The gas may be liberated by either of two methods, as follows:

1. The solution is boiled rapidly in a tall vessel, allowing one-half pint to each thousand cubic feet of space. The vessel should not be more than one-fourth full, since there is danger that the liquid may boil over and catch fire. The heating must be continued until the vessel is entirely dry. This method is cheap and efficient, but is somewhat objectionable on account of the danger from fire.

2. The gas is liberated by the addition of crystals of potassium permanganate to the formaldehyde solution. The solution is placed in a tall vessel which is set in a larger vessel near the center of the room and the permanganate added when all is ready. One-half pound of the crystals is required for each pint of the solution, and this must not be added until the attendant is ready to leave the room. Since this method destroys a portion of the formaldehyde, it should be used in the proportion of one pint of the forty per cent solution to each thousand cubic feet of space.

Before the gas is liberated by either of the methods, the doors and windows must be tightly closed and the cracks around them plugged with cotton or narrow strips of cloth. After exposing the room for five or six hours to the gas, it must be opened and thoroughly aired, but must not be occupied until the odor of formaldehyde has disappeared. This will require the most thorough ventilation for several hours. The lingering odor from the formaldehyde can be removed by sprinkling around water of ammonia.

**To Test the Purity of Water.** — Water free from organic matter is perfectly transparent, without odor or taste (unless containing minerals), and does not form a sediment on standing. Water having a slight milky or opaque appearance, which has the odor or taste of decayed material, or (in most cases) which forms a sediment on standing, contains organic matter and should not be used without thorough boiling. A simple chemical test for organic matter may be made with potassium permanganate, as follows:

A rather strong solution of the permanganate is first prepared by dissolving the crystals in distilled water. The water to be tested is placed in a clean glass vessel (beaker or test tube) and just enough of the permanganate solution added to give a light but distinct rose color. A drop of concentrated sulphuric acid is then added and the whole warmed to a temperature of 75° or 80° F. and then kept covered in a warm place for 24 hours. If the color partly or entirely disappears, organic matter which makes possible the development and retention of germs is present. If a control test is made with distilled water at the same time, the colors being brought to the same tint, the results can be more accurately determined.

Many of our large cities and most of our states employ chemists for determining the wholesomeness of water and foods, and these perform the service free of charge. In sending water for examination, one should first write for directions for collecting and shipping the sample to be tested. These experts are able to give definite information as to the presence or absence of harmful bacteria.

## CHAPTER XVIII

## CONTROL THROUGH ENVIRONMENT

ALTHOUGH our surroundings supply a variety of conditions that may injure health, the most potent are those that aid in the transmission of germs. The removal of these conditions presents a phase of disease prevention which concerns every person and one in which all can engage.

**Lines of Effort.** — Facts presented in the foregoing chapters show that disease germs are aided in their passage from one person to another in the following ways:

1. By particles of dust that are blown around by the air, and possibly by a foul and unwholesome condition of the air itself.

2. By means of articles used by people in common or that are passed from one person to another in everyday life.

3. By water and by food supplies.

4. By insects and other lower animal forms.

5. By people themselves.

Since air, dust, articles of different kinds, animal life, and people are tangible factors in our surroundings, they supply definite lines along which we may work in securing desired ends and purposes.

**" Bad " Air, an Agency in Germ Spreading.** — The fact has long been recognized that highly favorable conditions for germ propagation are in some way supplied by public gatherings. Especially do the diseases that attack the air passages — colds, grip, tonsillitis, measles, scarlet fever, diphtheria, meningitis, etc. — spread from the gathering of people within enclosed spaces. Although the bringing of "carriers" into close proximity with those susceptible to attack is the most important factor in such transmission, the unwholesome state of the air in improperly heated and ventilated rooms is also an agency of serious moment. An excess of moisture, a high temperature, and a stagnant condition of the air, all tend to lower the resistance of the individual and render him more susceptible to the germs that may be thrown into the air by coughing, talking, and laughing. These facts suggest the following precautions:

1. Proper methods of ventilating and heating rooms of public assemblage.

2. A method of coughing (explained below) which does not throw germs into the air. Loud talking, "talking into the faces" of others, and explosive laughing, should be largely avoided.

3. During epidemics of diseases attacking the air passages, public gatherings should be prohibited.

**Coughing and Germ Spreading.** — The common method of coughing is perhaps the most prolific means by which the air in crowded rooms becomes polluted. As a rule one does not cough unless there is an irritation of the throat or lower air passages, and such irritations in most cases result from the presence of germs. Though breathing and mild conversation do not loosen germs from the moist surfaces, the usual method of coughing separates a fine, germ-laden spray and throws it into the air. The particles forming this spray settle slowly, and on this account are easily breathed by those present. The approved method of coughing is to cough into a handkerchief (Fig. 78) or, if without this article, to cover the mouth with the hand. This method, already recommended for consumptives, should be practiced by all and for the reason that the germs which are but slightly disturbing to some, may, if conveyed to the mucous surfaces of others, develop disease.

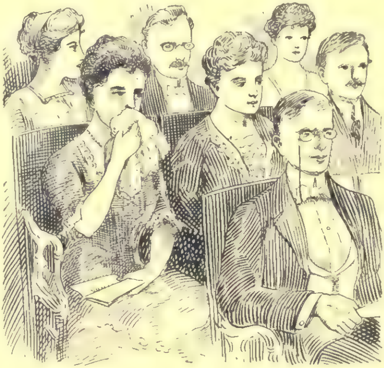

FIG. 78. — **Coughing is a means of Spreading Dangerous Germs.** The method of covering the mouth with a handkerchief should always be followed when coughing in the presence of others.

**Dangers from Human Excreta.** — Most of the ways by which our surroundings are rendered harmful through the presence of germs relate to people themselves. People develop most of the germs that cause disease; and these get into our environment as they escape from their human sources. They leave the body through its discharges, known as the *excreta*, and these include the secretions from the nose, throat, eyes, lungs, and kidneys, waste from the food canal, and pus from sores. On account of the dangerous germs which these are apt to contain they should be disposed of with the greatest care. When this is done the material substances that form our surroundings are much less likely to become way stations for the transfer of harmful germs.

**Dangers from Sputum.** — Microscopic examinations show that the sputum of people apparently well may contain the germs of tuberculosis, diphtheria, meningitis, grip, and other dangerous diseases that attack the air passages. Although they may not contract the disease themselves, their resistance being sufficient to protect them, they can nevertheless communicate the germs to those who are more susceptible. Hence much the same care that is exercised by the properly trained tuberculosis patient (page 357) in the disposal of his sputum, should be exercised by people in general. Especially should they not spit upon floors and walks, where the sputum will soon dry and be ground into dust to be lifted into the air, but into cuspidors, handkerchiefs, and other receptacles provided for the purpose.

**The Common Drinking Cup.** — In the everyday practices of life, many things which are brought into contact with the lips receive germs which are later conveyed to the lips of others. Pencils, handkerchiefs, tools, and eating utensils may all be so used by adults as to exchange germs, to say nothing of the over-social uses made by children of candy, chewing gum, apples, etc. In school, on trains, and at the public well, the same drinking cup is often used by hundreds of people. The method of germ exchange through the common drinking cup is so apparent that it has to a large extent been supplanted by the private cup and by devices, such as the drinking fountain (Fig. 79), which enable people to drink without bringing the lips in contact with any solid surface. If compelled to drink from a public cup one may

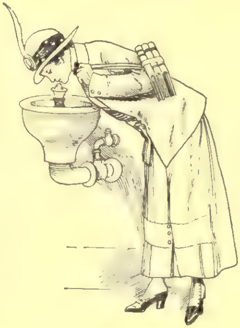

FIG. 79. —**A Sanitary Drinking Fountain.**

avoid the contact that exchanges germs by placing the edge of the cup under, instead of upon, the lower lip.

**The Common Towel.** — The contagious diseases of the eyes — pink eye (bacterial conjunctivitis), granulated eyelids (trachoma), etc. — have as their principal means of transfer the common towel for drying the face. Typhoid fever and diseases of the air passages may also be spread through this agency. In the small family the common towel is permissible only so long as all the members are in good health, and should be discontinued if one of them contracts a disease of the eyes, air passages, or body generally. In public lavatories the common towel should be replaced by paper towels.

**Disposal of Intestinal Excreta.** — Discharges from the food canal may contain any of the variety of germs that attack the digestive tract, such as those of typhoid fever, cholera, dysentery, and summer diarrhea, as well as the eggs or larvæ of hookworms, tapeworms, and the other animal parasites that infest this portion of the body. The discharges from the human intestines, both in sickness and in apparent good health, should be regarded as highly dangerous and should be disposed of in such a manner as not to contaminate the environment. They must not be deposited upon the ground where they may be distributed by flies or washed by rains into water reservoirs for public or private use. Nor should they be deposited in vaults or cesspools which are so situated that underground drainage may convey them to wells and cisterns. Properly located and constructed vaults and cesspools are permissible, but on account of the uncertainty of underground drainage they are a source of danger where people live in close proximity to one another. The device illustrated in Fig. 80, when properly installed, is considered both safe and convenient.

**The Sewerage System.** — For the disposal of intestinal and kidney excreta and of household wastes generally, especially in cities and villages, no method equals that of an underground system of drainage pipes with a common outlet. In such a system the drains must be sufficiently large to avoid clogging, and in order to prevent the escape of fluid and the penetration into the pipes of the roots of trees, the separate joints should be securely cemented together. Water traps must be installed wherever connections are made with houses in order to avoid sewer gas.[1] The main problem in the use of the public sewer, however, is the final disposition of the wastes. The common practice of emptying them directly into streams is highly objectionable, especially when the water from these is to be used for domestic purposes.

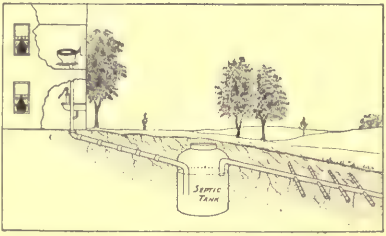

FIG. 80. — **A Sanitary Method of Sewerage Disposal** for a private dwelling. Solid matter remains in the water-tight septic tank where it decays. Water and the soluble organic matter, through a system of loose-jointed, underground tile, irrigate and fertilize the lawn or the garden. All pipes should be far enough below the surface to prevent freezing. (From *Health Bulletin No. 2*, issued by the Indiana State Board of Health.)

**Purification of Sewage Water.** — A number of methods for the purification of sewage water[2] have been proposed, the three following being the most commonly employed:

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[1] Though not "poisonous and germ laden," as was at one time supposed, escaping sewer gas is objectionable on account of its offensive odor.

[2] For a full discussion of this important subject, see Rosenau's *Preventive Medicine* or Harrington's *Practical Hygiene*.

1. *Purification by chemicals.* — The sewerage is passed into large vats or basins and there treated with alum, lime, ferrous sulphate, or other chemicals which cause the solid matter to be precipitated and render sterile the organic matter in solution. This method is expensive and it is not entirely satisfactory. Some of the chemicals used are destructive of aquatic life and the organic matter does not always remain sterile when diluted by the stream into which it is emptied.

2. *The method of irrigation.* — The crude sewerage, which may or may not have the coarser material screened out, is distributed over fields by ditches and other channels as in ordinary irrigation. The land must be porous and an acre serves for the sewerage of from one hundred to three hundred persons. This method is very successful and is extensively employed by European cities, notably Berlin and Paris. The crops from the sewage farms are said to be wholesome and the yield is frequently sufficient to pay the expense of operation.

3. *The septic process.* — This consists in the passage of the sewerage through closed, underground tanks which provide for the settling of the solid matter and the decomposition of this and dissolved organic material through the action of the anaërobic bacteria[1] and for further purification of the escaping liquid by aërobic bacteria in specially prepared filter beds. The filter beds are made of fine coke and sand and are of such numbers that each bed may have a resting period of one week out of every

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[1] With reference to their relations to the amosphere, bacteria are classified into two groups — *aërobic* which require free oxygen and which live only in the presence of air and the *anaërobic* which do not require free oxygen and which can thrive in places devoid of ordinary air, or atmosphere.

five. The septic method is economical and where adequate tanks and filter beds are provided is satisfactory. (See description of small septic tank in Health Work section.)

**The Problem of Household Dust.** — Dust is irritating to the air passages and the eyes, and as already stated may be a carrier of germs. While the keeping down of street and road dust is a sanitary problem of much importance, the dust which collects in dwellings and public buildings is the more likely to cause disease. The ordinary method of sweeping is highly objectionable both on account of the labor involved and the amount of dust which is thrown into the air. But the immediate disagreeable result is only the beginning of the trouble, since the dust which settles upon the furniture and upon wall decorations is so easily disturbed that it keeps the air continually charged with fine particles. To sweep with a brush broom (Fig. 81) of medium stiff bristles and to follow this, on smooth floors, with a slightly oiled cloth mop is to gain much in the suppression of the dust,[1] and every good housekeeper knows the advantages of sanitary dust cloths over the antiquated feather duster. The portable vacuum cleaner operated by electricity is another step toward satisfactory house cleaning, while the stationary vacuum cleaner represents a system which is practically ideal.

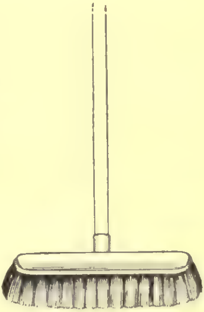

FIG. 81. — **A Brush Broom** of medium stiff bristles sweeps clean and raises little dust.

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[1] "If a dustcloth is wrung out of water containing a little kerosene and allowed to dry for a while it will hold enough oil to take up dust without injury to the finest furniture." — Coleman's, *The People's Health.*

**The Stationary Vacuum Cleaner.** — The stationary cleaner is installed in the house much on the same plan as the heating or plumbing system (Fig. 82). In the basement an electric or gasoline motor is connected with a fan or other device for creating vacuum, and this in turn with a device for separating the dirt from the moving air. Air-tight pipes connect the dirt separator

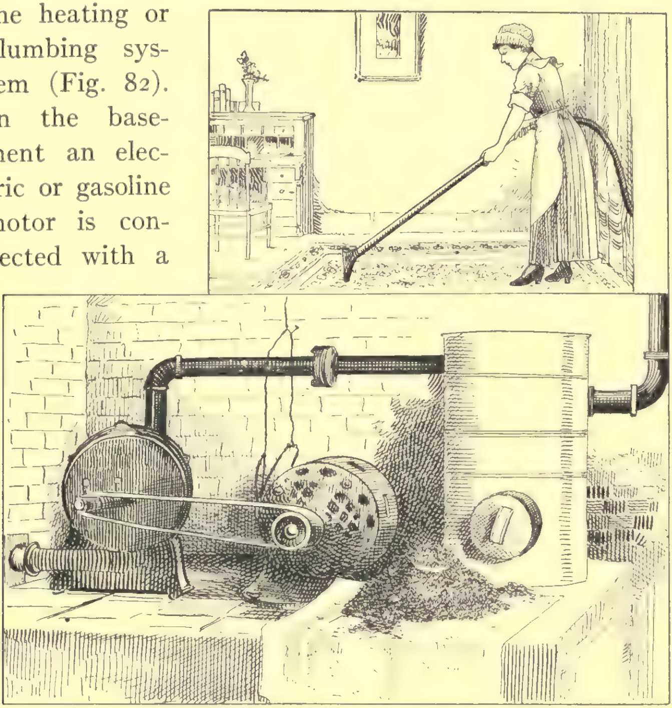

FIG. 82. — **A Stationary Vacuum Cleaner** and a room cleaned by it. The coarse dirt collects in the large drum, while the fine dust passes through the exhaust fan into the chimney at the left. By pressing a button upstairs the electric motor starts the exhaust. To prevent clogging, the pipes should be of large diameters (about two and one-half inches) and should be quite smooth on the inside. The dirt heap in the illustration is the result of several weeks of sweeping in a large house.

and the air pump with the different rooms where connection is made, through a suitable hose, with the tools for cleaning. A properly constructed and installed apparatus of this kind cleans rapidly, thoroughly, and *without raising dust.* No modern dwelling or public building should be considered complete in its equipment which does not have this efficient device for improving the indoor environment.

**Insects and Vermin.** — The advantages to health of keeping our environment as free as possible from insects and vermin was suggested in the preceding chapter. Although all the forms of animal life that are attracted to man by reason of the food or the shelter which he provides may not convey the germs of disease, they are all nuisances which greatly detract from the comfort of living. Especially should we wage unceasing warfare against rats, mice, and cockroaches; against house flies and mosquitoes; and against bedbugs, fleas, chiggers, and the parasites that live upon the body. Upon the numerous problems involved in the extermination of these forms of life, only a few practical suggestions can be made.

**Destruction of Rats and Mice.** — Traps for catching rats and mice are effective in reducing their numbers only in cases where people are especially persistent in their use. On account of the rapid breeding of these animals, catching one occasionally in a trap does not abate the nuisance. Poison carefully placed is an effective means of extermination and is to be recommended notwithstanding the bad odors that may arise from their decaying bodies. In most instances a little search will reveal the location of the dead animal which can then be removed.

Precautions against rats and mice should be taken in the construction of the house itself. All places, such as air spaces in the side walls, floors, and partitions, that may serve as harboring places, should be tightly closed. Since rats and mice are migratory, all entrance ways through the basement must be protected. It is well to remember also that these animals are unable to live where they can get no food. Hence to keep kitchen supplies in places inaccessable to rats and mice is to remove a cause for their presence.

**Destruction of House Flies.** — The chief difficulty in the complete extermination of the house fly is its enormous capacity to produce its young. The progeny of a single female fly may, under favorable conditions, reach several millions during a single season. Our main advantage lies in the fact that cold weather destroys flies; only a few live through the winter months. Because of this fact each year gives opportunity for a new and more successful campaign. Fly destruction should begin early in the season — in March or April in most climates — and be directed against the few survivors of the winter. The most effective methods of fighting house flies are the following:

1. By the destruction of breeding places. While moist organic matter (filth) of all kinds will hatch out the eggs of flies and develop the larvæ (Fig. 75), the manure heap from stables is especially adapted to this purpose. For this reason stable cleanliness — the removal of manure as fast as it is produced — is the most effective single method of preventing flies.

2. By the general use of large outdoor fly traps. These should be placed at the kitchen door, the garbage heap, the barn, and other places to which the flies are attracted. The fly trap attached to the garbage can (Fig. 83) is a device of special value in towns and cities.

3. By the thorough screening of all dwellings. Though screening neither destroys flies nor interferes with breeding, it prevents their carrying germs to the food as it is served upon the table.

4. By the use of small wire "fly swatters." No matter how carefully a house has been screened a few flies will get in. The "fly swatter" enables one to exterminate them as soon as they are discovered.

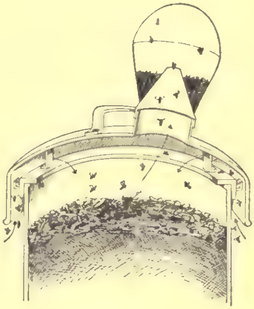

FIG. 83. — **Top of Garbage Can** to which is attached a small fly trap. The flies enter the can under the loose cover and are caught as they attempt to leave through the lighted opening above. Other places of entrance, not shown in the illustration, are provided where the trap fits on to the cover.

**Destruction of Bedbugs.** — In certain tenement districts in cities bedbugs are more than a nuisance; they are, like the house fly, a menace to health. There is good evidence that typhoid fever, relapsing fever, and other diseases may be transmitted by these insects, and skin infections may easily result from small wounds which they inflict. Since bedbugs frequently take refuge in clothing and may pass from one person to another in crowded cars and buildings, they are easily carried into well-kept homes.

Although their usual abode is the bedstead or the bedding, as their name implies, they also find harboring and breeding places in the walls and floors of buildings and in the cracks and open spaces of tables, desks, and other articles of household use. Bedbugs, as well as their eggs, may be destroyed with kerosene, and this is best applied to the crevices which they occupy by means of an oil can. A mixture of white of egg and red precipitate of mercury placed in their hiding places is also a standard remedy.

As in the case of rats and mice, preventive measures against bedbugs may be taken in the construction of the house. The walls and the floors should be impenetrable to these insects. Another preventive measure is the use of bedsteads, couches, and other kinds of furniture that provide no harboring places for them. The metal bedstead is a decided improvement, in this respect, over the bedsteads made from wood.

**Destruction of Chiggers.** — The cultivation of fields infested with these small insects is the most effective method of removing them. If the grass of lawns is cut short and kept free from useless herbage, exposing the chiggers to the sun, they are greatly reduced in numbers. The keeping of sheep in an infested pasture will also abate the nuisance. In addition to the sheep's keeping down the vegetation, the chiggers become attached to the wool where they are killed by the oil (lanolin) which it contains. Dusting the grass with flowers of sulphur and spraying it with a dilute kerosene emulsion mixed with sulphur is recommended for lawns.[1]

One living in a chigger-infested district may avoid ill effects by bathing, after each exposure, in strong salt water or in warm water with soap. By this precaution the mite is destroyed before it can penetrate the cuticle. The chigger bite should always be treated with some mild germicide (page 321) to prevent possible infection.

[1] Valuable bulletins on the destruction of house flies, mosquitoes, rats and mice, chiggers, and other insects and vermin, are now published by the United States Department of Agriculture. These can usually be obtained free of charge.

**House Pets.** — Though one hesitates to condemn a practice which gives so much pleasure to children as the keeping of pets, it is well to understand the dangers that may arise from this cause and to exercise necessary restraints. The bites of dogs, and the bites and scratches of cats, may inject dangerous germs and these and other animals petted by children may, through their furry coverings, convey germs from the sick to the well. Although most pets supply some compensation, there is no excuse for permitting stray dogs and cats to infest our cities and villages. The cats, in addition to making nights hideous, destroy large numbers of song and insectivorous birds.

**The Sanitary Home.** — Much of the work of securing an environment conducive to health has special reference to the home, and there is indeed no single place which should receive more thought as to its equipment and upkeep. Our life forces center naturally around the place where we eat, sleep, and spend most of our leisure. With reference to the house itself, the following suggestions deserve consideration:

1. The land upon which the house is built should be well drained, and if natural drainage be lacking, artificial drainage should be supplied.

2. The basement or cellar should be dry, well lighted, and ventilated, and should extend under the entire house.

3. Means should be provided for the proper ventilation and lighting of all the rooms. Each room should receive at some time of the day, if possible, the direct rays of the sun.

4. The side walls, partitions, and floors should be so closely constructed that they afford no harboring places for vermin.

5. The entire house should be planned with a view to saving work on the part of the housekeeper. Water and sewerage connections should be provided for the kitchen, the toilet, and the bath, and general heating and lighting systems should be installed. A stationary vacuum cleaner should also be included in the regular equipment.

6. During the summer months the windows and the doors should be thoroughly screened.

7. An upstairs, outdoor sleeping porch should be provided and kept ready for use as occasion requires.

8. Adequate arrangements should be made for pure drinking water. This item requires special consideration.

**The Collection of Drinking Water.** — The very best natural water for drinking purposes is that which may be collected from the clouds and stored in underground reservoirs, called cisterns. If the city water is pure, the construction of a cistern is, of course, unnecessary, but because most city systems are not entirely dependable, a private cistern should if possible be provided. Both in its construction and care the cistern should receive the most intelligent consideration. To avoid contamination from the roof, the gutters and downspouts should be kept free from dirt, leaves, and the nests of birds, and the plan should be followed of collecting water only after it has rained long enough to clean thoroughly the roof and pipes. Passing the water through a large filter with cemented walls and filled with alternate layers of clean, coarse sand

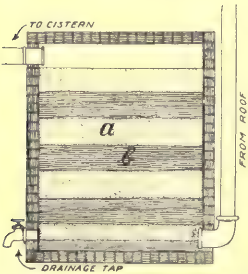

FIG. 84. — A **Water Filter** for the cistern. *a*. Layer of coarse sand. *b*. Layer of charcoal.

and charcoal (Fig. 84), is a further means of keeping roof impurities from entering the cistern.

A frequent source of contamination is the faulty construction of the upper walls of the cistern. These must be impervious to water, and they must be cemented up to, and tightly joined with, the stone or cement covering (Fig. 85.) The top of the cistern must be kept closed. The open top and the defective upper wall not only permit débris blown about by the air and wastes carried by water to enter the cistern, but various forms of animal life as well.

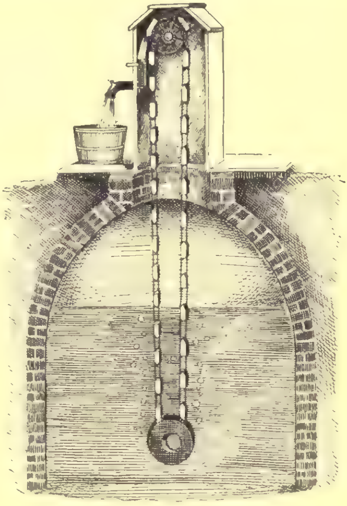

Fig. 85. — **The Elevator Pump.** As water is lifted from the cistern, air is carried down into the water. Each cup, moreover, contains a small hole in the bottom which lets the water trickle back when the pumping stops, thereby providing for further aëration. This pump is an excellent safeguard against the small amounts of impurities that get into the cistern in spite of the usual precautions.

Another source of contamination is from underground drainage. If there be a leak in the cistern walls, seepage from the sewer or from cesspools may carry in the germs of disease. The remedy, of course, is the construction of thick walls that are impervious to water. This is accomplished by laying the bricks or stone in cement and plastering the entire inside with a thick coat of cement and sand (two parts of coarse, clean sand and one of Portland cement). The custom, which prevails in some places, of omitting the stone or brick wall and plastering directly to the natural stone, is successful only in cases where the rock is firm and without seams or faults.

The kind of pump used in lifting the water from the cistern is also an important item in keeping the water pure. The pumps in which the water is drawn by a moving chain through a wooden tube are objectionable on account of the contaminating effect of the wood. On the other hand, the elevator pumps which raise the water by means of a series of galvanized cups attached to an endless chain, and which in descending carry air into the water (Fig. 85), are the means of oxidizing the small amount of organic matter that accidentally finds its way into the cistern.

**Well and Spring Water.** — If a well or a spring is depended upon for drinking water, the problem is to avoid contamination of the water from the vein by water from the soil or from the surface of the ground. The only solution is to wall out the seepage from the soil and the drainage from the surface. In the case of the well, a wall laid in cement must extend to, and make solid connection with, the rock below. It must also extend far enough above ground to keep out surface water. The top of the well, like that of the cistern, must be kept covered. Since the spring differs from the well only in the fact that the vein rises to the surface, it should be treated in the same manner. The enclosing wall should make firm connection with the rock from which the water issues and must be high enough to exclude all other water.

**The Indoor Place of Work.** — Next to the home in its effect upon the health is the office, store, shop, or factory, in which an increasingly large number of people must earn their livelihood. That these places should not supply agencies for the transmission of disease is generally admitted, and yet for economic reasons and through ignorance such agencies do abound to an inexcusable extent. In all cases where several people work together in the same room, special attention must be given to lighting, ventilation, the keeping down of dust, the exclusion of flies and other insects, and to other matters pertaining to health. Some form of medical inspection, whereby germ diseases are detected in their beginnings and the group in other ways protected from the individual, is also necessary in many of our modern industrial systems.

**Summary.** — Since disease germs in their passage from one to another must be for short intervals in our material environment, we are frequently able, through care, to prevent their transmission. Chief importance attaches to the disposal of the body discharges (excreta) since these carry the germs from the body and are the means by which water, food, clothing, and other articles of daily use become contaminated. The precautions relating to the sputum and the discharges from the bowels and the kidneys apply to both the sick and the well, since all are to some extent the carriers of germs. Insects, vermin, and even household pets are dangerous agencies in man's environment and should as far as possible be removed. While improvement of environment very properly begins with the immediate surroundings, such as the home and the place of work, it should extend to conditions supplied through the state and the nation. This larger view of control through environment is presented in Chapter XX.

**Exercises.** — 1. Enumerate the agencies in one's environment that may aid in the transmission of disease.

2. What conditions are supplied in crowded rooms that enable germs to pass from one person to another? How are these conditions avoided?

3. How are coughing, forceful speaking, and explosive laughing a means of spreading germs? Describe an approved method of coughing.

4. What substances are included under the term excreta? Why are human excreta more dangerous *to man* than those from other animals?

5. What precautions should be taken in the disposal of sputum? Why must well people also take these precautions?

6. What dangers arise from the common drinking cup? From the common towel? From the exchanges of pencils, toys, and food by children?

7. What dangers arise from vaults and cesspools? What precautions should be taken in the construction of a sewer system?

8. In what ways may dust aid in the transmission of disease? Why is the dust in public buildings more dangerous than the dust from the public roads?

9. Name some substitutes for the broom in house cleaning. What are their advantages? How is the stationary vacuum cleaner installed and operated?

10. Why should the home not be a harboring place for insects and vermin? What diseases are transmitted by the house fly? By mosquitoes? What one by rats? How may household pets transmit disease?

11. Describe the effective means of exterminating flies. Why must fly destruction begin early in the spring?

12. Describe a sanitary house.

13. By what means is a supply of pure cistern water obtained? How is contamination of well and spring water prevented?

14. Suggest methods of improving the school-room environment.

## Health Work

Work for the improvement of one's environment also supplies exercise. In this way it serves a double hygienic purpose. Every boy, and every girl for that matter, should learn those forms of practical exercise that enable them to keep up sanitary conditions and to improve appearances in and about the home. This means the acquirement of a rudimentary knowledge of several trades or occupations.

**Hygienic Uses of Cement.** — Perhaps no single substance can be made to serve so many hygienic purposes in and about the home as Portland cement. Mixed with broken rock or gravel in the proportion of one to six for walls or underbedding and with clean coarse sand in the proportion of one to two, or half and half, for mortar and for top dressings, cement may be used for putting the cistern, well, or spring in a safe condition; for the construction of a water filter for the cistern; for making walks about the house, a dry floor for the basement, and a septic vault for the privy; and for the construction of various sanitary arrangements in and about the stable, barn, or dairy. The use of the trowel and other tools for working cement is easily learned, as well as the preparation of the molds for casting walls, steps, etc. Although cement work of a serious nature should be left for the expert, one is frequently able to turn his exercise period to good account in securing improvements which, though important, are likely to be delayed on account of expense or inconvenience.

**Home Tinkering.** — There should be some one about every home who understands the use of the saw, hammer, plane, and other simple tools of the mechanic. Scarcely a week passes in most homes when some nail, bolt, or screw does not loosen or some door, screen, lock, or other part of the house get out of repair. The modern hygienic home, moreover, has its heating and lighting systems, its water and sewerage connections, its stationary vacuum cleaner, etc., and these in their operation require intelligent attention. Hence while depending upon the expert for improvements and repairs of a serious nature, the members of the home must depend upon themselves for meeting the simple emergencies that are constantly arising. If they are inefficient in these matters, they are likely to suffer numerous inconveniences and to be subjected frequently to insanitary conditions before obtaining help.

**Lawn and Garden Work.** — Garden work supplies an excellent variety of physical exercise and is a cheap means of supplying wholesome fruits and vegetables for the table. For hygienic reasons women and girls, as well as men and boys, should learn the art of gardening. Closely associated with the garden are the flower beds and the lawn, and in perfecting these the artistic sense is developed along with the muscles. In addition to the æsthetic advantages, the well-planned and well-kept outdoor surroundings add to the value of the property, and through their effects upon the mind, serve hygienic purposes. Every member of the home should be willing to do his part in securing and maintaining them.

**Fly Fighting.** — Every home should contain one or more well trained fly fighters as well as the necessary weapons — "fly swatters," outdoor fly traps, etc. — for exterminating these dangerous pests. Pupils in manual training departments, and others understanding the use of tools, may make their own traps (Fig. 86).

Box traps for stable windows are said to "catch flies literally by the bushel, and with no trouble and at trifling expense make it possible completely to rid dairies and farm yards of flies by halting the breeders before they begin to lay." [1]

**Mosquito Destruction.** — In the absence of winds, mosquitoes have been found to migrate but short distances from their breeding places. Hence if mosquitoes appear about the house, it is quite probable that they are hatching out in the rain barrel, the cistern, the privy vault, some small receptacle, or a watering trough, on the immediate premises. The appearance of mosquitoes should be the signal for a diligent search for the breeding place. When found, this should be treated as explained in the text.

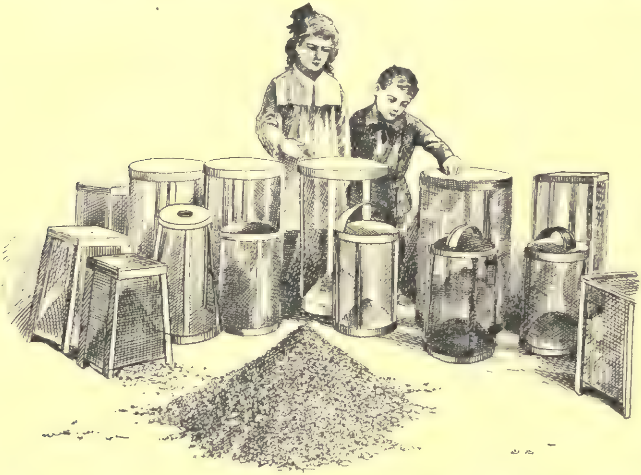

FIG. 86. — **Results from a Fly Crusade** in a western city. Note the different kinds of fly traps constructed by the children under the direction of the manual training teacher.

**The Problem of the Sanitary Privy.** — Sanitary privies are necessary in all places where toilet connections are not made with the public sewer. Of the different types that have been proposed, the two following have most to recommend them from the standpoint of convenience, economy, and safety:

*Type 1. For destroying germs by disinfectants.* — A single privy seat is built with sufficient room beneath for a water-tight receptacle, such as a galvanized iron tub, and with a small door at the rear for removing this for emptying. (If desirable two seats with two receptacles may be provided.) Within the privy is kept a large closely covered jar containing a disinfecting solution and about a pint of this is poured upon the waste each time the privy is used. (Enough of the solution should be added to keep the contents soft, but not enough to cause splashing.) The cheapest disinfectant for this purpose is milk of lime (page 364), this being prepared by the barrel and kept convenient for refilling the jar in the privy. This mixture must be well stirred, however, when transferred from one vessel to another and before using. (Both the jar and barrel must be kept tightly covered to prevent deterioration from the air.) A few hours before the receptacle is to be emptied the contents are completely covered with the disinfectant to destroy any germs that may not have been previously reached.

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[1] Prof. C. F. Hodge, *Learning Disease Prevention in School*, Vol. iii. of Transactions of Fourth International Congress on School Hygiene.

*Type 2. For destroying germs through septic processes.* — A septic privy is one constructed on the principle that the body wastes themselves will, by a process of decomposition, destroy the harmful germs. The plan generally followed is to dig the usual privy vault, but to have this extend a couple of feet beyond the small house, and to lay the bottom and side walls in cement, making them impervious to water. The extension, which provides for the removal of waste, must have a suitable cover and be kept tightly closed. When everything is ready the vault is filled to the depth of two feet with water and over this is poured a half-gallon of crude petroleum for repelling insects and keeping down odors. On becoming two-thirds full the vault should be emptied.

The contents from either of these privies may be finally disposed of by emptying in the manhole of a sewer or by burial. If buried they should be placed at least two feet under ground, and three hundred feet and downhill from any sources of water supply. Since it is practically impossible to maintain a sanitary condition of the privies in a community by relying upon private families, it is best for towns and villages to maintain a scavenger service under official direction whose duty is the care of privies and the removal of body and kitchen wastes.

**The Septic Tank.**[1] — A more effective and convenient method of disposing of bodily excreta, and one which can be employed by several homes in a village as well as by a single household, is that of the septic tank. To construct a tank for a family of five persons,[1] several lengths of four-inch glazed sewer tile, two tees (T's) and five bends (L's) of the same size, and enough concrete, brick, or stone, to build an underground, covered tank five feet long, two feet nine inches wide, and two and one-half feet deep (inside measurements), are required. A three inch partition placed two feet from the entering pipe, divides the tank into two compartments (Figs. 87 and 88), thereby providing for a settling chamber (two by two and three-fourths feet) and a larger septic chamber (two and three-fourths feet each way) where the anaërobic bacteria do most of their work of decomposing the sewage. Each chamber should be plastered with good cement, two to one, well troweled on the surface and provided with a manhole for cleaning or occasional repairs. The cover for this may be made of concrete, but need not be air-tight. As there are no odors if the tank is working properly, it may be placed anywhere on the premises, but should be at least seventy-five feet from any well or cistern to prevent contamination in case of accidental seepage. After the water passes the filter bed (described later) there should be no danger.

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[1] For data on construction and for accompanying illustrations, the author is indebted to Dr. Louis Murbach of Detroit, Mich. Having tested this tank in a practical way through a number of years, Dr. Murbach recommends it as one of the simplest and safest devices for the disposal of bodily excreta.

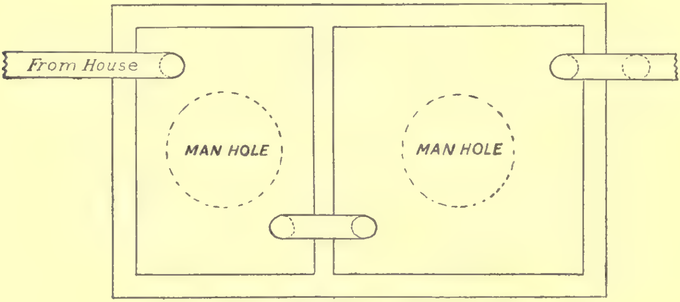

FIG. 87. — **A Small Septic Tank** — Top view.

The sewer tile from the bathroom or water-closet should enter the settling tank near the top and at one corner. Inside it empties by an L under the surface. An open T in the opposite corner of the settling chamber (Fig. 88), by connecting with a nine inch L, carries the waste beneath the surface, into the septic chamber, this being necessary to avoid disturbing the film of working germs. Liquid from about nine inches below the surface is now passed out through the outlet siphon near the corner farthest from the other siphon and this is carried through a loose-jointed draintile under the lawn or garden (Fig. 80), or into a filter bed (three by twelve feet) where the aërobic bacteria complete the work of purification. This filter bed must, of course, be lower than the tank so no back flow can occur. Just outside of the tank the outlet siphon should be vented by an upright pipe connecting with the surface of the ground, in order to prevent the siphoning off of the surface film. In winter the filter bed should be covered with straw or hay to prevent freezing at the outlet, and in severe climates the tank should also be covered. The warmer the tank is kept the better the germs work. Only toilet paper should be used and waste from the kitchen must be disposed of separately.

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[1] If more people or several houses are to use the same tank, the rule is to allow seven cubic feet of tank space for each additional person.

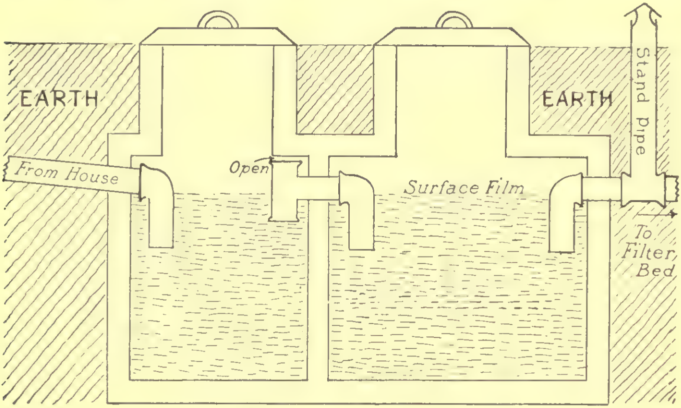

FIG. 88. — **A Small Septic Tank** — Side view.

# CHAPTER XIX

## CONTROL THROUGH THE PHYSICIAN

"He who is his own physician will have a fool for his patient."
— *Old Proverb.*

EVEN when one is thoroughly informed upon all matters pertaining to his physical welfare and is diligent in the application of the principles of control, the occasion will arise when he needs expert advice and practical assistance in keeping up his health. His recourse at such times is the physician. The aid which he derives from this source, however, will depend largely upon his attitude toward the physician and his method of availing himself of the physician's services.

**The Physician's Preparation.** — In addition to having a knowledge of hygiene superior to that of the educated layman, the competent physician is well versed in the causes of disease, the symptoms by which any particular disease is recognized, and the methods by which its effects are to be counteracted and the patient restored to health. The seriousness of the physician's calling is indicated by the fact that his activities are regulated by law. Before he is granted a license to practice he must complete a course in a medical school[1] which is chartered by the state and must pass the examinations of a duly authorized medical board. If later he prove incompetent or violate certain moral or ethical principles relating to his profession, his license may be revoked. But in spite of the laws requiring preparation, there are vast differences in the service which various physicians are able to render. These must be taken into account in selecting the one who is to direct to a greater or less extent one's physical well-being or that of some member of his household. The wisdom exercised in this selection often means the saving of life.

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[1] Although it is true that many of our medical schools have been deficient in the past, both as regards equipment and teaching force, the last few years have seen great improvements. The small schools are being abandoned and the larger ones improved. Moreover, there has been everywhere an extension of the medical course; six years and a year or two of hospital

**How to Select a Physician.** — In the selection of a physician, one should be guided by his preparation, by his efforts to keep abreast with the times, by his success in curing disease, by his frankness and honesty, by his standing with other physicians, by his public work for the prevention of disease, and by the extent to which he instructs his patients in hygienic living. Special importance should also be attached to the estimate which the physician places upon his own work. Does he regard it simply as a means of gaining a livelihood, or does he recognize in it an exceptional opportunity for serving his fellow man? In other words, is he professional? It need hardly be said that the professional physician is one who devotes the major portion of his thought and energy to his work and is not absorbed by business or other matters of an extraneous nature.

**The Specialist and the General Practitioner.** — Another fact which must be taken into account in the selection of a physician is that no one person can be equally

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service is now the generally accepted standard. Young men who contemplate medicine as a life work should seek the best preparation obtainable. Their own success, as well as the needs of the people, demand it.

skillful in all lines of medical work. The layman desires the doctor best able to cure his particular disease. The medical profession contains many specialists — men who are skilled in relieving particular ailments — and one must often decide between a specialist and the general practitioner. Definite advice upon this point, however, cannot be given. Although it is the general custom to refer defects and diseases of the eye, bodily ailments that require surgical operations, serious diseases of the brain and nervous system, chronic diseases, and diseases of an obscure and difficult nature to the specialist, general practitioners are to be found who are highly successful in these different lines of work. Hence, a matter of greater importance than whether a physician be a specialist or a general practitioner, is his preparation, success, personality, and general intelligence. Because the work of the family physician requires a rather intimate knowledge of the whole field of medicine and skill in treating a great variety of diseases, he should be chosen from the ranks of the general practitioner. Having given sufficient thought to the selection of a physician, one should be slow to make a change. It is a great help to both doctor and patient to know each other well.

**Quacks and Charlatans.** — On account of laxity in the enforcement of laws regulating the practice of medicine, it has been possible for unscrupulous people with little or no medical education to play falsely the rôle of the physician — making pretentious claims which they are unable to fulfill and extracting money for unscientific and often injurious treatment. This practice is abhorrent from every point of view. Not only does the sick person lose his money, but often sacrifices, through loss of time and through injurious drugs, his chances for recovery.

The simple remedy against the quack and the charlatan is to employ only physicians whose methods are known to be sound and to purchase no kind of treatment which is not endorsed by those competent to judge. Since many of the fake practitioners parade under the name of specialist, it is well to have the advice of the regular physician in deciding what specialist, if any, should be consulted.

**When to Call the Physician.** — Everyone who would make sure of continuous good health must be able to recognize bodily conditions which make advisable the calling of a physician. One should at least consult a physician for any of the following reasons:

1. For severe pain or discomfort in any part of the body, especially if this be long continued or cannot be related to some understood condition.

2. For persistent or recurring swelling and for the development of hard places or lumps in any part of the body (page 407).

3. For fever attended by sore throat, skin eruptions, vomiting, or severe pain, or which continues after cleansing the bowels.

4. For severe colds.

5. For nervous disorders, both serious and mild, which are not relieved through a proper conservation of the nervous energy (Chapter XII).

6. For general depression and weakness which does not disappear with rest and sleep.

7. For broken and dislocated bones, and also for sprains and bruises which interfere with freedom of motion. Infected wounds and sores, all gunshot wounds, and wounds requiring stitching should receive the attention of the physician.

8. For nosebleed which cannot be promptly checked, especially when one is in a run-down condition or is recovering from some disease.

9. For chronic constipation and for constipation alternating with diarrhea.

10. For abnormal variations in the activity of kidneys.

11. For any unnatural condition which is chronic.

**Significance of Pain.** — The sensation of pain is nature's warning of existing danger. It is a signal of distress sent out through the nervous system. Certain forms of pain, such as headache, neuralgia, and pains in the region of the heart, often arise from nervous exhaustion or from irritation of sensory nerves as already explained (page 234), and all kinds of pain are more pronounced when the nervous system is overworked or exhausted. Pains are excited both from chemical and from mechanical causes and these may be present in all parts of the body. Rheumatic pains of the muscles and the joints may arise from waste accumulations, or from local congestions of the blood and the lymph, and from the presence of germ toxins in the blood. Pains in the region of the abdomen result from accumulations of gas in the stomach and intestines, from acids and other chemical agents, from congestions, from the displacement and infection of organs, and from other causes.

Many of our pains are of a trivial nature and may be ignored, and we should not trouble the physician with pains which we can relieve through hygienic means. Pains which cannot be so relieved, pains which result from causes that are not understood, and pains that persist, however, should be called to his attention. It is well to avoid thinking very much about our pains. The attempt to analyze them has the effect of exaggerating their importance and of developing a mental condition (hypochondria) which interferes with the proper management of the body. Pains indicating any serious condition will in most instances impress themselves upon the consciousness.

**Causes of Swelling.** — Swelling is caused by an abnormal accumulation of lymph at some part of the body. It may occur from local irritation, such as a blow, the bite or sting of an insect, or the entrance of bacteria. Abscesses, boils, and all kinds of skin infections are attended by more or less swelling. Constitutional disturbances, such as weaknesses of the heart and blood vessels, deep-seated germ attacks, and profound changes in the chemical activities of cells, also cause swelling. Swelling of the feet on standing is a frequent accompaniment of kidney disorders, swelling of the joints may result from impaired metabolism, and swelling of any of the abdominal organs may arise from a variety of causes. Swelling from constitutional causes and also from local and deep-seated infections requires the attention of the physician. Swelling from any wound, sprain, or bruise which persists after the subsidence of the original irritation should also receive his attention.

**Chilling and Fever.** — In many of the abnormal conditions that may arise there is a disturbance of the heat-producing and regulating mechanism, chilling and fever being the usual accompaniments. Although chilling may result from a general lowering of the body temperature, it more frequently results from a disturbance of the circulation which checks the flow of the blood to the skin. As a consequence, the internal temperature is often abnormally high during the chill. Germ attacks, mechanical injury, digestive disturbances, extreme fatigue, severe exposure, and numerous other causes may induce fever. In all cases of continued or recurring fever the physician should be consulted. The causes and conditions that induce fever are too complex for one without medical training to prescribe the mode of relief. It is best, moreover, not to depend upon the sense of touch in determining if fever be present, but to use a clinical, or fever, thermometer (Fig. 89) for this purpose. A few suggestions from the physician will enable one to use this instrument with accuracy and to interpret the readings properly.[1]

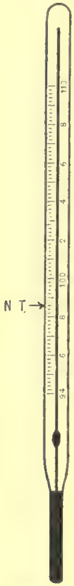

Fig. 89. — **A Clinical,** or fever, thermometer.

**Early Symptoms of Common Diseases.** — Both for the sake of the patient and for the safety of others, the physician should be called early in all kinds of infectious diseases. The symptoms of the beginnings of the more common of these are as follows:

1. *Typhoid Fever.* — As a rule typhoid fever comes on gradually and the patient is unable to tell definitely when he began to feel ill. The disease usually begins with headache, backache, lassitude, loss of appetite, and constant fever which gradually becomes higher from day to day. The tongue is coated white, becoming brown after a few days, and the mouth dry. The abdomen, as a rule, is slightly distended and tender. Nosebleed and diarrhea are also among the early symptoms and there may be mental confusion and restlessness at night.

2. *Tuberculosis of the Lungs (Consumption).* — The most constant early symptom of consumption is a dry,

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[1] To avoid the spreading of germs by the fever thermometer, it should be thoroughly washed before and after each test.

hacking cough which is most troublesome at night and in the early morning. (Expectorations occur at a later stage.) Loss of appetite, decrease of weight and energy, and shortness of breath from slight exertion are also important early symptoms, and these may precede the cough. The patient is usually pale and has an increase in pulse rate. There is also a slight rise of temperature at some time during the day (which can be tested by taking the temperature every two hours) and frequently profuse sweating at night. One having reason to suspect the beginning of tuberculosis should apply at once to a careful physician for a thorough examination (page 345).

3. *La grippe.* — Grip is usually characterized by fever; pain in the back, head, and muscles; catarrh of the nose, throat, or lower air passages; and general depression. The attack, which is quite sudden, begins with a chill. There is a feeling of tightness in the chest, and usually a dry, hacking cough.

4. *Smallpox.* — The initial symptoms of smallpox are quite similar to those of grip, but the onset is more violent. The patient is suddenly seized with chill which is followed by fever and accompanied by pains in the head, back, and legs. Vomiting is a very frequent symptom. The temperature rises quickly and on the first day may reach 103° or 104° F. The eruptions which characterize smallpox occur about the fourth day, but in the interval between the initial attack and the eruptions there may be an entire cessation of the symptoms.

5. *Measles.* — This disease begins as a severe cold attended by fever.[1] The eyes are red and watery, the

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[1] The similarity of the symptoms of measles, grip, scarlet fever, diphtheria, and certain other diseases, to those of cold (coryza), is accounted

nose runs, the throat is sore, and there is more or less coughing. An important early sign is the appearance of whitish spots, each surrounded by a zone of red, upon the inside of the cheeks opposite the back teeth. The skin eruption, or rash, which characterizes measles occurs about four days after the initial attack, first appearing on the face and neck and afterward spreading to the trunk and limbs.

6. *Scarlet Fever.* — This highly dangerous disease of children begins with fever, sore throat, vomiting, lassitude, and headache. The attack is usually sudden, and with young children convulsions are a frequent symptom. The tongue is furred, and the patient may be either stupid or restless and delirious. After twenty-four hours a scarlet pin-point rash appears — first on the neck or chest — which spreads rapidly over the entire body.

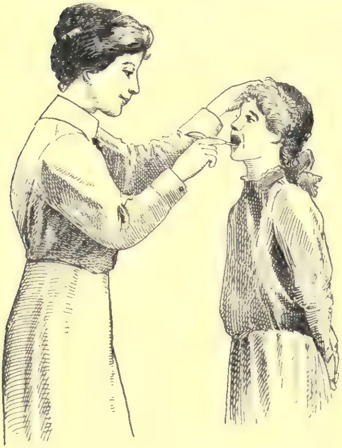

FIG. 90. — **Examination of Tonsils** at school. A strong light from over the teacher's shoulder illuminates the throat. The large spoon should be thoroughly washed with strong soap and water after each examination.

7. *Tonsilitis.* — Tonsilitis begins much like grip, the main symptoms being fever, headache, backache, pain in

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for by the fact that all of these ailments result from attacks of germs upon the mucous linings of the air passages. Since the serious maladies cannot at first be distinguished from those that are comparatively harmless, it is well to regard all severe attacks having the appearance of colds with more or less of suspicion. During epidemics children having what is ordinarily regarded as cold should be kept out of school and away from other children until assurance is given by the physician that they have nothing worse.

the limbs, sore throat, and pain on swallowing. The tonsils (seen by pressing down the tongue with a spoon handle [Fig. 90]) are swollen, much reddened, and dotted over with yellowish-white spots. In some cases only one tonsil is affected.

8. *Diphtheria.* — In its beginning the symptoms of diphtheria are very similar to those of tonsilitis, even to the spots upon the tonsils. While the diphtheria spots are usually whiter than those of tonsilitis and spread from the tonsils to the adjacent surfaces, it is never safe for the layman to risk his judgment on a diagnosis, especially when the question under consideration is that of calling a physician. Both tonsilitis and diphtheria require medical aid, and the success of the antitoxin treatment for diphtheria depends upon its application *at the earliest moment.*

9. "*Membranous Croup.*" — *Membranous croup is diphtheria* of the lower part of the throat (larynx) in the region of the Adam's apple. It is frequently mistaken for ordinary croup, and as a result does not receive the prompt medical treatment which is necessary. A croupy cough which lasts through the day and which is attended by fever, hard breathing, and lassitude is very likely to be diphtheria. There may, or there may not, be white spots on the tonsils or in the back of the mouth. This form of diphtheria, like the usual form, requires the antitoxin treatment, and requires it early.

10. *Appendicitis.* — Attacks of appendicitis are recognized by sudden pain in the abdomen, usually in the region of the appendix (right lower quarter of abdomen), by fever of a moderate degree, by digestive disturbances — nausea, vomiting, and frequently constipation — and by tenderness and pain on pressure over the appendix.

Although pain is a valuable symptom in diagnosing appendicitis, it is never in itself a reliable guide. Pain in the region of the appendix may arise from other causes and is said to result sometimes from an overactive imagination.

11. *Inflammatory Rheumatism*, or rheumatic fever, is characterized by fever, "sour sweat," scanty and highly colored urine, and swelling of the joints. The disease is not only painful but dangerous on account of the tendency of the inflammation to spread to other organs, especially to the heart. Attacks upon children are, on this account, serious and require the prompt attention of the physician.

**Disease Sequels.** — Not only is the mistake often made of not calling the physician soon enough, but in many instances his services are dispensed with before the patient is out of danger. As a result relapses occur and conditions (sequels) develop which may be more dangerous than the disease itself. Typhoid fever may be followed by rhuematism, boils, diseases of the heart, liver, and kidneys, and less commonly by insanity and tuberculosis. Sequels of scarlet fever are inflammations of the joints, kidney disease, abscess of the middle ear which may result in deafness, inflammation of the heart lining (endocarditis) which may permanently damage the valves, and serious nervous disorders. Measles may be followed by bronchitis, pneumonia, tuberculosis, kidney disorders, and troubles of the eyes and ears. Indeed, almost any kind of germ disease is apt to leave the body charged with toxins which, through exposure or other indiscretions, may pave the way for serious ailments.

The safest plan during convalescence is to keep in close touch with the physician, consulting him upon all points about which there may be doubt, and following his advice upon all occasions.

**Necessity for Coöperation.** — Since the physician has neither in himself nor in his appliances or medicines any power to cure, but can only achieve results through the direction of bodily agencies that influence health, the most important factor in recovery is often the intelligent coöperation of the patient in efforts to secure relief. Especially does it devolve upon the patient, or upon the nurse or others having him in charge, to supply the hygienic conditions during the intervals between the physician's visits. Conservation of the nervous energy, the proper ventilation and heating of the sick-room, the adjustment of food to the patient's condition, and other things, are often of more vital concern than the administration of drugs. If these matters are not properly looked after the physician's efforts are of no avail. The informed and rightly disposed patient will not only follow his doctor's directions, but will exercise good judgment in all matters that may influence his condition.

**Prevention of Diseases Resulting from Impaired Metabolism.** — A most important method of using the physician as an agency for the control of health is that of presenting oneself at periodic intervals for a thorough physical examination.[1] The value of such examinations is perhaps most apparent when considered in relation to the diseases — including disorders of the kidneys, liver, heart, skin, and the body generally — that result from impairment of the processes of metabolism (page 96). As previously stated (page 219), these diseases encroach slowly, and even in their beginnings produce symptoms that are easily detected. Their development at this stage, moreover, is easily checked by shifts in the diet and changes in the general mode of living. Hence the importance of knowing if such attacks are impending.

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[1] Insurance companies appreciate the importance of such preventive work to the extent that several of them provide for periodic examinations of their policyholders by competent physicians free of charge. They can well afford this expense since the knowledge thus gained is a practical means of reducing the number of death-claims which they would otherwise have to pay.

By examination of the urine and the blood, by taking the blood pressure, and by noting the condition of the organs of digestion and of elimination, the well-informed physician is able to detect any tendency toward these diseases, and through his knowledge of the causes upon which they depend he is able to point the way to continued good health (page 220).

**Relief from Cancer.** — Of almost equal importance to the prevention of diseases of metabolism, is the finding of relief, through the physician's aid, from the dread disease of middle and past middle life, known as cancer. Cancer is not caused by germs, as might be supposed, but is an abnormal bodily growth. "It is composed of cells which are the offspring of the cells which make up the body, but which have lost their tendency to remain in their normal numbers and location and to perform their natural function. They grow wildly and without limit, becoming enemies of their parent cells, destroying the tissues about them as they grow and spreading out like the roots of a tree."[1] If not removed by a surgical operation, cancer eventually destroys the body. Safety lies in bringing to the attention of a competent physician the presence of any abnormal condition (precancerous lesion) which may be the beginning of cancer or which may later develop into the disease, and obtaining through his aid, such surgical assistance as may be necessary. A surgical operation when the disease is confined to a small area will remove the entire growth with little difficulty, but if the cancer develops until its roots are widely extended, it is practically impossible to remove every trace of it. And the smallest bit that remains is capable of starting the growth anew.

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[1] From University of Missouri Bulletin by Dr. F. A. Martin on *The Early Diagnosis and Treatment of Cancer.*

The conditions which precede cancerous growths include chronic sores of the skin and mucous linings; moles, warts, and wens which are inflamed and sensitive without apparent cause; and nodules and lumps in the skin, breasts, and deeper tissues which do not disappear when relieved from pressure or irritation. Most frequently perhaps do sores of the lips, tongue, and gums, when allowed to persist, become starting points of the disease, a case of this kind being the smoker's burn. The seriousness of this sore lies in its tendency to linger, if smoking is not stopped, from the continual irritation of the pipe or cigar.[1]

The wide prevalence of cancer (one out of every eleven past middle age is said to die of it) and the fact that it is on the increase, make all measures for the removal of predisposing causes of the greatest importance. While these are not fully understood, our present knowledge sanctions the following precautionary measures:

1. Living as nearly as possible the truly hygienic life. Healthy tissues are our surest safeguards.

2. Avoidance of excess in the use of meats. While the present widespread belief that meat eating is a predisposing cause of cancer is not fully substantiated, this precaution is necessary to general good health.

3. Avoidance, by medical aid if necessary, of all chronic sores of the skin and mucous linings and the protection of all parts of the body from *continued* irritation.

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[1] The abnormalities that may develop into cancer are, according to medical literature, of two kinds — the *benign* and the *malignant*. The former get well of themselves or, if they persist, undergo no further development and do no harm; the latter sooner or later develop into cancer. Unfortunately the benign growths are frequently indistinguishable from the malignant so that one to avoid the possibility of cancer has sometimes to submit to an operation which the surgeon is unable to say is absolutely necessary.

4. The earliest possible consultation with a competent physician relative to any abnormality, referred to above, that is in any respect menacing.
5. Avoidance of fake cancer specialists.

**The School Physician.** — The very large number of school children having physical defects which interfere with normal development and progress in school, suggests yet another way by which the physician can render valuable service in the control of health. Unless the foundations of health be laid in childhood, the problem of avoiding disease in later periods is much more difficult. Indeed, the matter of securing expert attention at a time when it will influence the whole course of life is too important to be left to the good intentions of parents. It should be provided through our system of public schools. The example set by our larger and more progressive cities of providing medical inspection and supervision should be followed everywhere. No town of more than four thousand inhabitants should be without its regularly employed school physician, and rural and village schools should be provided for through some method of district employment. The school physician should possess the highest qualifications obtainable.

**Prevention Better than Cure.** — Important as is the work of the physician in curing disease, the service which he can render in its avoidance is of greater value to the individual and society. Even when we are successful in our conflicts with disease, we are the losers in suffering and anxiety, in the time spent in sickness, and not infrequently in some abnormal condition which results from the disease. No army can win battles without loss to itself, and seldom does the body conquer any serious disease without some permanent depreciation of the health.

Avoidance of disease, on the other hand, is like having the enemy surrender without giving battle. To secure this end we should employ all agencies possible, and these include the services of the physician.

**Remuneration.** — If the physician is only paid to cure and not to prevent disease, he must naturally attend to this phase of his work. Why should he devote himself to disease prevention and deprive himself of prospective patients when people do not appreciate this service to the extent of paying for it? Although many physicians, from their enlarged view of their profession, do give much time without compensation to matters of personal and public hygiene, neither the individual nor the community has any claim on them for such gratuitous service. As a simple business principle, we must expect to pay for value received.

**Summary.** — Because of the inability of the individual to encompass the entire field of health, recourse must frequently be made to the expert in health control — the well-informed, skillful physician. To use the physician to the best advantage, one should know when to avail himself of his services and should have some rational basis for judging medical competency. The physician should be called early in all infectious diseases, and his services should be retained until all danger from relapses and disease sequels has fully passed. In detecting and counteracting diseases resulting from impaired metabolism the physician is able to render valuable service, and it is only through the physician's aid that cancerous growths, when once started, can be checked. Since by prevention of disease, the suffering, bodily danger, and financial loss incident to combating it are avoided, the physician should be adequately remunerated for this phase of his work.

**Exercises.** — 1. State the place of the physician in the general plan of health control.

2. Upon what basis should the competency of the physician be judged?

3. How are unscrupulous and incompetent medical practitioners to be avoided?

4. Enumerate the bodily symptoms which make advisable the calling of the physician.

5. State the general causes of pain. What is its purpose? When should the physician be consulted with reference to pains?

6. State the causes of swelling. What kinds of swelling suggest some serious condition?

7. From what different causes may fever arise? Why should the physician be consulted in all cases of continued or recurring fever?

8. Give the early indications of typhoid fever. Of tuberculosis. Of smallpox. Of measles. Of scarlet fever. Of diphtheria.

9. Describe the form of diphtheria known as "membranous croup." Why must this receive the same treatment as the regular form?

10. What are disease sequels? How are they to be avoided?

11. State the advantage of periodic physical examinations by competent physicians.

12. Enumerate the different ways through which the physician may prevent disease. Why is prevention more important than cure?

# CHAPTER XX

## THE LARGER CONTROL

"The public health is the foundation on which rests the happiness of the people and the power of a country. The care of the public health is the first duty of a statesman." — *Lord Beaconsfield.*

"The people's government, made for the people, made by the people, and answerable to the people." — *Daniel Webster.*

BECAUSE man is a social being, health control cannot be a matter simply of the individual. The results of physical transgression are not limited to those who commit them, and people may coöperate for purposes of health, just as they coöperate for commercial and industrial purposes. In the relations of individuals to individuals, of individuals to society, and of society to its different members, are to be found the means of a larger, but, at the same time, a more difficult phase of control than we have so far considered.

**Health and the Social Order.** — Long ago men found that certain ends and purposes could be attained through living and working together which could not be attained through individual effort. From the small social units, such as the clan and the tribe, with no fixed place of abode, have developed the organized governments of the present time. No man lives unto himself, but each is a part of some one of the smaller social groups which make up the state or the nation. And to the extent that people are united by social and political ties, are their destinies blended. They rise and fall together, and together they supply the moral and the intellectual atmosphere which shapes their lives. Social agencies for controlling health are found both in the immediate environment and in the methods by which state and local affairs are conducted. The application of such agencies is in most instances coincident with the establishment of conditions that make for the general good.

**Social Conditions Conducive to Disease.** — The view is quite generally held that social conditions have made possible the existence of infectious diseases — that most of the species of germs that infest the body could not have originated without the close relations which exist between people of the same group. While this view cannot be scientifically demonstrated, we know that the spread of germs of almost every communicable disease is by methods which make people themselves responsible for their transmission (Chapter XVIII). Whether it be from the natural intermingling of individuals, from negligence in the destruction of infectious material, from permitting conditions to exist whereby insects and vermin develop which distribute the germs, or from other causes, it is plainly evident that we have a power of control which is being exercised only to a slight degree. We know also that social and economic conditions are to a large extent responsible for low body resistance, for disorders of the nervous system, and for diseases of metabolism. In recognition of its responsibility in the spread of disease, society is already doing much to safeguard the health of its members.

**Health Control in the Modern City.** — Perhaps the greatest advance in methods of social control is to be found in the health work of our modern cities. This presents the greatest variety of effort. It includes protection from the vicious practices of the criminal classes, isolation and quarantining of cases of infectious diseases, inspection of foods, an abundant supply of pure water to all parts of the city, proper disposal of waste and sewage, medical inspection of the public schools, and care at public expense of sick people who are without the means of caring for themselves. The modern city has also its efficient board of health before whom citizens may lay complaints, and who, during epidemics, prescribe such special regulations as may be necessary for their control.

Commendable as is the health work of our modern cities, however, it should be looked upon as merely the beginning of what can be accomplished through coöperation in the establishment of conditions that make for the general good. While the lines along which advancement may be made are too numerous and diverse for exhaustive treatment, it is hoped that the present brief study may aid our young people in understanding their duties and responsibilities as members of society and as citizens of the state and nation.

**Effects of Social Disharmony.** — That the failure of people to get along peaceably with each other is responsible for a large amount of unhappiness, ill health, and loss of life, is shown by the reports of the daily press. The number of cases of murder, suicide, insanity, and nervous prostration, traceable to this cause are pitiful to contemplate. The deaths resulting from hydrophobia[1] are few compared with those from human anger uncontrolled, and quarrelsome people are in some localities more destructive to life than malaria or typhoid. In the home, most of all, are the effects of unharmonious relations expressed in suffering and disease. All this is in violation of a fundamental law of hygiene — that of *harmonious social adjustment.* Hence, whatever may be done through precept, example, or legal enactment, to improve the social relations of individuals, will redound to the healthfulness of people in general.

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[1] Thought at one time to result from the dog's becoming intensely angry or infuriated.

**Control of the Criminal Classes.** — Society has always been hampered by people who have no regard for the welfare, rights, and privileges of their fellows or for the good of society as a whole — the so-called criminal classes. The criminal is one who would advance his personal interest, or obtain his desired end, regardless of any injury which he might inflict upon others. The extreme of this type is found in those who do not hesitate to take life when this is the means of paltry gain. The criminal class, however, is composed of many grades of people and includes those who operate through indirect methods, as well as those who openly commit their depredations. The hygienic importance of preventing criminal practices lies in the avoidance of bodily injury, the safeguarding of property, and the elimination of the widespread fear which such practices excite. While force directed by law must be employed to a large extent in controlling the criminal classes, there is another method of accomplishing the same result which, in individual cases, is even more potent. This includes secular and religious instruction and the removal of social and economic causes for the development of criminals.

**Criminal Business.** — But along with the control of the criminal classes, there must be such regulation of business interests that injury may not be committed under the guise of trade. Buying and selling, exchanging products, manufacturing and transportation are all to be regarded as legitimate means through which the individual benefits himself while ministering to the wants of others. There are lines of business, however, in which the articles sold or the services rendered do harm instead of good. Even in supplying a legitimate want, the service may be such as to work injury to many while conferring benefit upon only a few. All such business is criminal in the sense that the individual is criminal who advances his own interests by injuring others or by interfering with their rights and privileges. A striking illustration of a criminal business is the liquor traffic as carried on in this country.

**The Liquor Traffic.** — That the manufacture, distribution, and sale of alcoholic beverages comes under the head of criminal business is shown by the harm which follows their use. Through the effects of these beverages in the production of disease and accidents, not far from 100,000 people annually lose their lives in the United States. The amount of money which is wasted upon liquor is about equal to what we spend for bread — two billions of dollars annually. In the face of all this loss, alcohol ministers to no essential need and serves no legitimate purposes which cannot be better served in other ways.[1] Hence the liquor traffic not only must be

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[1] The excuse of those engaged in the liquor traffic is that they are supplying a demand on the part of the people. While this is seemingly the case, the fact must be taken into account that the demand for alcoholic beverages is from those who have developed an unnatural appetite from their use and that this appetite has been in most cases developed through the traffic itself. Indeed, it is a part of the liquor business to keep up this unnatural demand, this being accomplished by the development of new drinkers. Through ingenious advertisements, public displays of goods, and the social influences emanating from the saloon, the liquor interests manage to find new recruits as fast as the army of old drinkers dies off. It is by this means that the business is perpetuated.

"The liquor traffic presents a striking case of a huge industry inducing classed as a criminal business, but also must be included in the same category as the individual criminal who destroys life for paltry gain.

**The White Slave Traffic.** — Worse even than the alcohol traffic, but dependent to a considerable extent upon it, is the business which reaps gain by ministering to the animal passions of men. This loathsome business is so destructive to the health and lives of the degraded women engaged in it, that the promoters (chiefly men) must be constantly in search of new recruits. On account of the fact that innocent young women are often enticed or entrapped into this life, retained by force, and are sometimes literally bought and sold, the enterprise has been referred to as the white slave traffic. Its relation to the general problem of health is in part indicated by the fact that two of our most terrible diseases, gonorrhea and syphilis (page 360), are propagated by the vice upon which it depends.

**The Duty of Society.** — The social organization is pledged to protect its members and to safeguard its own future. Hence it must deal with a criminal business in much the same manner that it deals with the individual criminal. It must curtail its effects and prevent, if possible, its continuance. Traffic in alcoholic beverages, in cigarettes, in opium, in absinthe and other drugs, and in human beings, will in time be suppressed in civilized countries — it is to be hoped in the near future. But since it requires not only good laws to banish evils, but also vast numbers of good citizens to uphold and enforce these laws, social progress is usually no more rapid than the production by society of the right kind of citizens.

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people to buy what harms them. It is militant capitalism rotting people's lives and character to distil dividends." — *Rauschenbush.*

**Poverty and Disease: A Social Remedy.** — It is estimated that there are in the United States four million people who are dependent upon public relief; an equal number who are practically destitute, but who bear their distress in silence; and ten million who have incomes insufficient to maintain them in bodily vigor.[1] This means that perhaps twenty per cent of our people are, from insufficient food and clothing and from inadequate housing, seriously handicapped in their conflict with disease (page 435). Although inefficiency and the absence of thrift are the fundamental causes of much of this poverty, there are social and economic conditions — high cost of living, low wages, absence of work at any wage, criminal businesses that prey upon the weak, etc. — which make it extremely difficult for those dependent upon their labor to supply hygienic necessities. This suggests that the remedy for disease-producing poverty [2] lies largely with the social order — the suppression of agencies that degrade and impoverish the workingman and the establishment of social and economic conditions that aid him in his struggle.

**Effects of Selfishness.** — In addition to practices which are directly and perniciously antisocial and which are detrimental in a large degree to the public health, society has to deal with that general characteristic of human nature whose outward manifestation the poet Burns referred to as "man's inhumanity to man." The instinct for self-preservation is a natural and necessary trait, and when exercised with proper restraints is beneficial alike to the individual and society. In all ages, however, there has been a constant tendency for the stronger, the more cunning, and the less moral, to exercise their selfish instincts to the detriment of their fellows. In the past, this was responsible for slavery and the various forms of tyranny. In the present, especially in our own country, it is responsible for several conditions as follows:

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[1] Robert Hunter, *Poverty.*

[2] Since the term poverty is relative we cannot hope for the time when none will be poor in comparison to others. Disease-producing poverty, on the other hand, is a well-defined condition which will cease to exist when the causes upon which it depends are removed.

1. For the oppression of the laboring classes as shown in places by low wages, long hours of work, and the employment of child labor.
2. For the division of people into classes exercising hatred.
3. For the general tendency to overcharge for any service or commodity when the opportunity offers.
4. For much of the criminal business referred to above.
5. For the resistance which arises when measures for the general good are proposed.

These are abnormal and undesirable conditions. They not only react harmfully upon the less fortunate, but they threaten the existence of the social order itself.

**A Law of Social Hygiene.** — The laws of the social order are analogous in many respects to the laws of the body. The body supplies conditions favorable for the development of its cells (individuals), but it also takes measures to prevent the abnormal development of any cell or group of cells. If such abnormal development occurs, it is the result of disease and is not in accord with the body plan. The dread disease, cancer, described in the preceding chapter, is a development of this kind. By the growth of cancerous cells, the whole body becomes impoverished and diseased. That a corresponding social condition may exist is quite obvious.

The cancerous cells of the social order are those people who would get more than they give and who, in planning for themselves, overlook the rights and needs of others and the good of society as a whole. The perpetuity of the social order depends upon the normal, though not equal, development of all its members, and is endangered by the perverted inclinations and abnormal accumulations of the few.

**Social Restraint.** — It is evident that a restraining influence must be exercised in the social order similar to that exercised by the body, and such is manifest in the laws which are imposed for the general good and for the protection of individuals. The government which is too weak to restrain the overselfish tendencies of its subjects is, in a sense, diseased — the victim of cancerous cells which it can neither control nor destroy. Better, however, than the restraint which must be enforced through law is that which the individual enforces upon himself. Realizing the obligations that rest upon him as a member of society, he curbs his selfish tendencies at all points where they would injure others, and in the exercise of his liberties he is careful not to infringe upon the rights and privileges of his neighbors. Such persons constitute the highest type of citizens.

**International Restraint and the Prevention of War.** — Along with the restraint which the individual must exercise or, failing to exercise, must have forced upon him, is a species of restraint which the various social organizations or governments should exercise toward each other. History is replete with records of wars which have been without justification. In the violence of war, the laws of hygiene are ignored and conditions that make for disease and death reach their most acute stage. The continuance of life becomes a matter of chance, though varied somewhat by the relative strength and preparedness of the contestants. War, moreover, destroys the best of the human species, leaving the weak and diseased to propagate the race, the victors faring but little better than the vanquished in this respect.

From the horrible demonstration afforded by the last European War of the effectiveness of the modern military equipment — high explosives and rapid-fire guns, air-craft for scouting and for overhead attacks, and submarines for concealed attacks of vessels below the water surface — the necessity for preventing war has never before been so impressed upon all thinking people. It behooves "the men of science, who have fought all kinds of infectious disease and have improved the world's health conditions, henceforth to become interested in national and international politics, in order that their great work for all races of men may not be interrupted by the mismanagement of governments."

**Conservation of Natural Resources.** — Each of the modern social groups occupies a portion of the earth's surface which is set off by well-defined boundaries and which supplies the material basis for its existence. On account of the dependence of health upon food, clothing, shelter, and other resources of a material nature, the method of using and caring for the territorial possession has a bearing which is in a large sense hygienic. If the great natural resources — field, forest, minerals, water courses, etc. — are improperly managed, only a few years may suffice for their destruction or for rendering them useless. Hence each succeeding generation has the problem of so administering nature's gifts that their capacity for supplying human needs shall not be diminished; that future generations shall find in them the same means for sustenance and enjoyment that it has found.

This means that a policy of conservation must be practiced in all things material and that there must be no ruthless exploitation and no unavoidable waste. While this principle must be applied in many directions, it needs especially to be applied to conditions upon which the lives of people fundamentally depend.

**Management of the Soil.** — The top fertile layer of the land, known as the soil, is a highly unstable mixture which is readily affected both by mechanical and by chemical causes and especially by the growth of crops. Properly managed, the soil will last forever; improperly managed, it soon loses its essential elements or is washed away. On account of the almost direct dependence of human life upon the soil, its conservation stands first among such problems.[1] To maintain soil fertility upon a given territory is no less important than protection of this territory from invasion by a foreign foe. From the standpoint of human needs the loss of soil is even more to be deplored than loss of territorial possessions. Land without soil is of little value to any class of people.

The United States possesses such vast amounts of rich farm land that her agricultural resources seemed at one time unlimited. There was consequently little thought given to soil conservation, but when fertility was exhausted at one place, new land was opened at another. This method has reached its limit, however, and America now, like European countries, must deal with problems of soil conservation. This means that the essential constituents of the soil shall be replaced as fast as they are withdrawn by crops, that destructive washings be prevented, and that our whole system of farm management be placed upon a scientific basis.

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[1] According to the distinguished German chemist, Liebig, the decrease of soil fertility, even more than war, is the great fundamental cause of the decadence of nations.

**Remedial Measures.** — Keeping in mind the various forces of a social nature that bear directly or indirectly upon the general problem of health, we may now consider briefly the means for setting these into action. Whatever the methods employed, they must be adapted to the customs of the people and the general plan of government. In a people's government, or democracy, the essential aim must be the enlightenment of the masses upon the great problems of health and upon the methods of coöperation by which health conditions are established. Essential to such enlightenment is a system of education which shall reach both the young and adult members of society.

**What the Public Schools Should Do.** — In the work of the grades considerable attention should be given to the establishment of health habits on the part of the pupil — habits of posture, of exercise, of eating, of cleanliness, and of nervous control. The health of the pupil should be a matter of educational concern, and the teacher in the grades should be qualified to direct his physical as well as his mental development. In the high school, the study of physiology as a science should be taken up, and in this connection there should be taught the principles of health control. In the universities, colleges, and normal schools, definite work in the preparation of leaders and teachers in the domain of health should be carried on. In all departments of school work — the grades, the high school, and the institutions of higher learning — those elements of character should be stressed which are essential to harmonious social adjustments, to coöperation for the public welfare, and to good citizenship generally.

**Education for Citizenship.** — A recent criticism of our public schools is that they have failed to develop in the pupils the traits that would make of them the best citizens; that in training them individually and inspiring them with ambitions for financial and professional success, they have failed to develop a dominating sense of justice and of fair dealing and a keen appreciation of moral obligations. In other words, the schools have left undeveloped those social and ethical qualities that put people into helpful and sympathetic relations with each other and that enable them to perform effectively their duties to the social group of which they are a part. To the extent that this criticism is just, American education has been away from rather than toward the application of social agencies to the control of health.

The prevention of disease through social agencies means *coöperation*, and this principle must be applied locally as well as on a large scale. It also means an increase of taxes — money spent for the general good — though the increase is insignificant as compared with the cost of disease. Hence education which is social in its aim and which stresses our duties toward others as well as toward self, is of especial importance in its relation to the problems of health. The individual must be able to realize the mutual dependence of people upon each other and the value that accrues to self when the good of all is conserved.

**Education for Adults.** — "Education is as long as life," and there are many reasons why definite agencies should be provided in our country for those beyond the developing years of youth. The need of a well-informed citizenship, the ever-changing nature of our systems of knowledge, and the fact that "one never gets too old to learn," are the sound arguments for such provisions. Especially does the establishment of a national system of health control depend upon the coöperation and support of mature people, ends which cannot be attained unless these be informed upon the causes of disease and the methods of control. Fortunately we already have many agencies, such as newspapers, books and periodicals, public libraries and lecture bureaus, and social and commercial clubs, which may be utilized for this purpose, but the provisions for adult education need to be even more definite and systematic. In this connection special mention must be made of the bearing of the work of the great religious organizations upon the problems of health.

**Religious Training and Health.** — As long as selfishness continues to be a potent factor in the causation of disease, religious and moral training must be given due consideration from the standpoint of social hygiene. In at least three fundamental respects are religious organizations necessary and vital factors in the prevention of disease:

1. As educational institutions, teaching altruism, social harmony, the power of love, the brotherhood of man, mutual helpfulness, and other social principles that constitute the essentials of good citizenship.

2. As agencies for the establishment of habits which conserve the forces of the individual, such as those of temperance, purity, nervous control, and the one day of rest in seven.

3. By leading people, through teaching and the formation of habits, into a general mode of life which is hygienic in the broadest sense.

A serious defect in our system of religious training is that it fails to reach a very large percentage of the people, and this loss is national as well as personal. In a democracy in which individual liberty is stressed and in which legal and political restraints are largely removed, self-restraint and the desire to do right for right's sake are essential to the public welfare. More than any other cause, perhaps, does "righteousness exalt a nation," and it is to be hoped that in the near future an effective means may be found whereby the great social principles taught by the church will be brought into more vital relations with the masses.

**The Field of Eugenics.** — Health control means conservation of what is best in the individual and in society. While the conservation of forest, field, and minerals is of vast importance, the conservation of those bodily elements which make for strength and vigor in the human race should be of more vital concern. With our knowledge of the laws of heredity and of the methods by which these may be applied to the improvement of animals and plants, there is much reason for the belief that social agencies may be set at work whose purpose shall be the development of a greater resistance to disease and the improvement of the body generally. A few facts of this nature have already been established. Every feeble-minded child and every child born into the world with criminal tendencies, increases by that much the social burden. For this reason, the criminal and the feeble-minded should not be permitted to marry. The offspring of diseased parents, especially the tuberculous, the alcoholic, and the syphilitic, are greatly handicapped from the standpoint of health. A wise precaution, on this account, would be the requiring of all candidates for marriage of health certificates from authorized physicians.

But the problem is deeper than the legal remedies can penetrate. It involves the general desire which people have for children and the general attitude which they hold toward the race. It also involves a knowledge of the conditions under which healthy offspring are produced and properly nurtured during infancy and childhood. Of especial importance is a general understanding of the principles of health control, both as they apply to the individual and to the race. *The broad basis of eugenics is hygiene.*

**The Need of Organization.** — No matter how many and what influences may be at work for the improvement of people, for the dissemination of knowledge, and for the development of the spirit of coöperation, organization is a factor without which we cannot succeed. Team work on a large scale is essential. There should be in our national government a department of health, and in each state there should be a corresponding department, but differing from the present state board of health in that its essential purpose be disease prevention. It should be the purpose of the national and state departments to organize existing forces and to enlist such new forces as may be necessary for the eradication of disease. In the organization, direction, and control of health agencies, one of society's most trusted servants, the physician, will find an almost new field of work.

**A New Rôle for the Physician.** — While there will always be a need for the services of the skilled physician in the cure of disease, there will be a place in every community for one or more trained specialists whose essential preparation has been along the line of understanding climatic, economic, social, dietary, bacterial, and other causes of disease and the means for removing or counteracting these causes. It will be the work of these specialists to establish and maintain conditions that make for health and to educate the people in the method and spirit of hygienic coöperation. Remunerated by the state and responsible to the community as a whole, these will prove efficient leaders in the social conflict with disease.

**Health Control and Social Evolution.** — Even a casual study of the problem of applying social agencies to the promotion of health shows the close relation of this to the larger problem of improving the social organization and of developing a more perfect humanity. The solution of the whole problem means no less than *the control by the social order of its own evolution.* Though such control can hardly be said to have been attained by any people in the past, it is no more than what should be expected of future generations. Why should not a nation be in full control of the conditions that determine its destiny? The principle of cause and effect applies just as surely to the lives of nations as to the lives of individuals, and control in the one case is no more impossible than in the other. Nor is the method of national control greatly different from that of controlling the bodily welfare. It lies in the conscious manipulation of underlying causes to the end that the social order as a whole becomes more efficient and enduring.

**The Problem of America.** — Among all the nations of the globe, none is more fortunately constituted for the control of her destiny than the American Republic. With her efficient system of public schools; her newspapers, periodicals, and other means for the rapid distribution of knowledge; her generous, intelligent, and publicspirited citizens; her natural resources and strength as a nation; and her governmental machinery whereby the people may select the most competent for leadership, the task of consciously directing her own evolution is by no means insurmountable.[1] Her chief concern, however, will always be the development of good citizens — men and women who, in discharging duties to self, are thoughtful of the rights and privileges of others and who are zealous for the public good. To the extent that these are developed will this government "*of the people*" be directed along the lines of unfolding greatness and helpfulness toward "*all the people.*"

**Summary.** — Because man is a social being his opportunities for life and health are dependent upon conditions supplied through the group of which he is a part. While the control of social agencies that pertain to health is impossible by individuals working alone, they can be directed toward desired ends and purposes through the intelligent coöperation of people aided by the machinery of government. Social conditions which aid in the distribution of germs must be removed, one class of people must not be permitted to prey upon the others, natural resources upon which life and health depend must be conserved, and unnecessary war must be avoided. While the problem is difficult, it is simplified by the fact that social conditions making for health control are the same as those that make for the general welfare and the perpetuity of the nation. Its solution is the next great step which our own nation must take if it would realize more fully the ideals upon which it is founded.

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[1] "To develop our life and our resources; to supply our own people, and the people of the world as their need arises, from the abundant plenty of our fields and our marts of trade; to enrich the commerce of our own states and of the world with the products of our mines, our farms and our factories, with the creations of our thoughts and the fruits of our character — this is what should hold our attention and our enthusiasm steadily, now and in the years to come, *as we strive to show in our life as a nation what liberty and the inspirations of an emancipated spirit may do for men and for societies, for individuals, for states, and for mankind.*" — President Woodrow Wilson.

**Exercises.** — 1. State the relation of the individual to society. Why are social organizations necessary?

2. In what different ways are people themselves responsible for infectious diseases?

3. Enumerate the various kinds of health work carried on by the modern city.

4. What unhygienic conditions result when the relations of individuals are unharmonious? What elements of character enable one to live peaceably with his fellows?

5. State the essential difference between a good citizen and a criminal. In what ways does the control of the criminal classes benefit the public health?

6. What are the characteristics of a criminal business? Illustrate.

7. What is the duty of society toward any kind of business which is criminal in its practices?

8. How does selfishness become a cause of ill health? When does it become necessary for society to restrain selfish individuals?

9. How does war overthrow all the laws of hygiene? What are the means for the avoidance of war?

10. In what ways does the welfare of the social group depend upon its geographical situation and the extent of its territory? Upon the fertility of the soil?

11. What hygienic benefits will accrue to cities from improving the conditions of rural life?

12. What kinds of health work should be carried on by the public school? Why must education in health control continue throughout life?

13. Explain the special need for religious and moral training in America. How is this need to be more fully supplied?

14. Explain the meaning of the term eugenics. Through what general means is the race of human beings to be improved?

15. How is it possible for a nation to direct and control its evolution? How would the inauguration of a national system of health control aid in this work?

## Health Work

Health work of a social nature presents two general lines of effort — the establishment of social conditions that make for health and the suppression of harmful agencies that operate through the social order. Both lines are so broad in their scope and present such variety in their methods that only their more practical phases can here be considered.

**To Avoid Personal Injury by Criminal Business.** — One method is to avoid the formation of habits that lead to the patronage of such business. The importance of habit in holding customers is so well understood that habit development is frequently a regular part of the business. Tobacco firms, for example, can afford to go to great expense to fasten the cigarette habit upon boys because by this means they secure life customers. Not only should the well-informed person avoid the formation of bad habits himself, but should do all in his power to prevent their formation by those not informed, especially children.

Another method lies in the selection of proper companions. If one habitually associates with the users of alcohol and tobacco, it is likely to be only a matter of time until he is a user himself. The social incentives supplied by the crowd are too strong for the average person to resist. On the other hand, association with non-users not only keeps him from temptation, but is a means of establishing a safeguarding prejudice.

A third method consists in the destruction, through legal means, of the business itself. This is accomplished by the combined efforts of good citizens and is the most important of all means of protecting the individual and society at large.

**Methods of Fighting Criminal Business.** — The criminal business is to society what the animal parasite is to the human body. It derives protection and nourishment from its host and produces harmful effects in return. As we destroy body parasites so must society do away with criminal practices of all kinds. The burden of this fight falls upon the good citizens — those who understand the effects of such practices and are willing to work for their overthrow. The properly disposed citizen will find many ways of coöperating with others for this purpose, such as the following:

1. Aiding in the campaign of education which must precede any kind of legal enactment.

2. Contributing money for the support of trained workers who devote their time to the problems of social betterment.

3. Giving moral support to officers in the enforcement of laws. Experience teaches that every law for the prevention of criminal business fails unless it be persistently enforced, and that officers are unable to enforce laws that are not backed by strong public sentiment.

No one believing in the principles of health control can be indifferent to social demands during the conflicts for the overthrow of criminal businesses. If he is not injured personally by them, he is still a partner in the great social order which must bear their added burden. Because he loves his country and his fellow men, he will enlist in these conflicts and fight earnestly for success.

**Avoidance of Social Dangers by Girls.** — While a few innocent girls are captured by force and dragged into a life of shame, most victims of the social evil can trace the beginnings of their downfall to influences and indiscretions that are all too common among thoughtless young women. In the first place, the girl should carefully guard her own conduct. She should avoid all forms of "looseness" in her general manner and should cultivate that modest reserve that brooks no familiarity from the opposite sex. In dress she should avoid the excessively ornate and the styles that unduly expose the body.

In the second place, the girl should be careful of her social environment. This injunction becomes especially important if one leaves home to seek employment among strangers. She must know the reputation of the people from whom she accepts employment and those with whom she is associated in her work. She must never make her home in any lodging house or hotel of a questionable character and she must be particular about the ideals and standards of those whom she accepts as companions and friends. Before accepting the attention of any young man she must be sure that his moral standards are above reproach.

In traveling the rule should be followed of accepting no service from strangers and of avoiding pick-up acquaintances. For advice and assistance she should consult only the regular employees on trains, in depots, and at hotels. On the streets one may apply to policemen for information and also for assistance. If stranded in a city relief should be sought through the Young Women's Christian Association; if in a small place, from the president of the relief society or from the mayor of the town. It is always safest, of course, for the young woman to travel with an experienced companion.

**To Promote Social Harmony.** — In addition to what has already been suggested upon this subject (page 294), it is well for the individual to study the effect of his own words and actions upon the words and actions of other people. When one has determined the nature and measured, so to speak, the intensity of the social effects which he is constantly producing, he is in a position to control social stimuli emanating from himself — to suppress those that are harmful and to improve those that "excite friendly feelings and noble deeds in others." Because certain individuals never take into account the effects which they produce upon the minds of other people, they pass through life as social irritants, causing unhappiness and strife both for themselves and for others.

**Tests of Good Citizenship.** — The good citizen is characterized by the following traits:

1. He is actively interested in all questions touching the public good.
2. He pays his taxes willingly and insists upon their wise expenditure.
3. He favors public education and public improvements.
4. He is sympathetic with the workingman and is desirous that everyone be given a fair chance.
5. He is a student of questions touching the welfare of his government and is active in placing men of honesty and efficiency in charge of public affairs.

To become such a citizen must be the aim of everyone seeking the largest control over his life and the largest opportunity for his fellow men.

# CHAPTER XXI

## HOW CONTROL OF HEALTH IS LOST

> "Who is so deafe or sò blind as hee
> That willfully will neither heare nor see?" — *Heywood.*

THERE are many ways in which one may lose temporary or permanent control of health or enter upon a state in which the problems of health are attended with greater difficulty. In fact, every principle of health control discussed in the preceding chapters is suggestive of a method through which control is lost. In the present chapter certain special liabilities are discussed.

**Loss through Ignorance.** — Ignorance of the plan of the body and of the effect of things and conditions upon the body is perhaps the most potent cause of failure in keeping up the health. How frequently is one who has contracted some avoidable disease heard to make the excuse, "I did not know." In our present state of knowledge, however, such excuses are not justifiable. *It is our duty to know.* Nor does one need to be profoundly ignorant to lose control of health. "A little knowledge is a dangerous thing" when it pertains to the body even more than when it pertains to affairs in general. Our knowledge of health principles must be definite and comprehensive, and we must understand our special needs and be able to supply them from day to day.

Every modern worker should be a student of health. He should understand the forces and agencies that influence his well-being and he should be able to manipulate them to his advantage. This requires an investment of time, effort, and some money, but according to England's great statesman, Gladstone, there is no kind of investment which yields so great a return. The fact that Gladstone was a student of health accounts in no small degree for his long and successful career.[1]

**Loss through Neglect.** — Neglect ranks close to ignorance as a cause of ill health. Knowledge of health principles is of no avail unless this be put into practice. To avoid cumulative effects that terminate in disease, as well as temporary declines of resistance inviting to attacks of germs, the activities of each day should be along hygienic lines. Opposed to this method of living is the strong tendency of people to do what they want to do or what they have been in the habit of doing, rather than what health needs require that they should do. While they may be careful so long as the body is impaired through misuse or is threatened by disease, they again become careless as their condition improves. Health control is a life-long problem, and success in its solution requires that we avoid occasional neglect as well as continued neglect.

Warning must here be given to the students of this course who, in the application of the principles studied, have experienced improvements in health. To keep what has been gained, as well as to make further progress, this work must be continued. To stop is gradually to drift back into the old habits and the old condition, and to experience no better health than would have been possible without a knowledge of the methods of control.

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[1] Gladstone, even in his last years, was most persistent in keeping up his exercise, a favorite pastime being that of chopping wood.

**Loss through Poverty.** — Poverty interferes with the maintenance of good health by limiting one's capacity for supplying bodily needs. It avails little to know the conditions upon which health depends if we are unable to supply them. Poverty deprives some of food and shelter. It forces others to work when they should rest. It compels the sick to go without the physician's aid and the old and decrepit to struggle along without sympathy or good cheer. It causes parents to overwork their children and to deprive them of education. It hovers over many a home as a hideous specter — the destroyer of happiness and the harbinger of disease and suffering. A sufficient income must always be a prerequisite .of health control.

Because health requires a material basis, no one should scorn the attribute of thrift or the practical knowledge which enables him to spend money to the best advantage. Every workingman should own his own home, and he should also have resources upon which he can draw in cases of emergency. If he has others dependent upon him, he should carry an insurance policy upon his life. To attain these ends with a small income requires the most careful management, and one is often tempted to economize by methods which in the end entail a loss.

**False Economy to be Avoided.** — Any kind of economy which is at the expense of health is false economy. While there is much to be saved in the matter of food and clothing, there is loss if these economies are carried too far. The body must be sufficiently supplied with proteins, carbohydrates, fats, and mineral salts (page 122), and it must be kept sufficiently warm. Failure to supply actual needs means the lowering of health and efficiency, and this in the long run more than counterbalances the gain. Another kind of false economy is the curtailment of the advantages of education. The wage earner without elementary schooling is at a great disadvantage in the modern industrial struggle. Even the withdrawal of boys from high school in order to begin work is shown by statistics to be unwise from a business standpoint. To economize in any manner which directly or remotely impairs efficiency or diminishes opportunity for advancement is false economy.

**Loss through Affluence.** — It is a common observation among physicians that the diseases resulting from impaired metabolism (page 216) are much more widely prevalent among the well-to-do than among those of moderate means. This result depends mainly upon two causes. In the first place, one whose income affords opportunity for leisure, tends to deprive himself of sufficient physical exercise, and as a result suffers a decline in the vigor of his cells. In the second place, he is apt to be lavish in the use of foods, selecting those that appeal strongly to the appetite and eating more than his mode of life requires. A further cause is sometimes found in the irregular habits and dissipations which money and leisure make possible. The trouble of course is not in the possession of wealth, but in the failure to use it properly.

**Hygienic Uses of Wealth.** — Although there are many methods by which accumulating wealth may be legitimately expended, those which have for their purpose the broadening and enriching of life, are most to be commended. From the standpoint of self, nothing is perhaps more important than a home which is in all senses hygienic — one which conforms to the conditions already set forth (page 383) and which provides for healthful methods of recreation. While such a home need not consume large sums of money, for those in affluence it may include the hygienic luxuries, such as the gymnasium, the swimming pool, and extensive grounds for outdoor games and sports. Wealth is in a large sense hygienically expended also when used to secure that broad mental training which gives one a true conception of life and its duties, and especially so when used to secure that special training which enables one to safeguard his own health and the health of others.

But many Americans have the problem of disposing of a surplus which is over and above what supplies all of their needs. Guided by selfish motives one is likely to seek investment for this which will further increase his income, but if he is sensitive to the needs of humanity and conscious of his relations to society, he will use the surplus for the benefit of the less fortunate and to advance the general good. Our country is indeed fortunate in having so large a number of wealthy citizens who feel their obligations to the country from which their wealth has been derived and who, on this account, are alert to find ways of distributing funds which will diminish human suffering and advance the interests of the commonwealth. The advantages to individual and community health that have resulted from the social investments of these people are beyond computation.

It should be noted, on the other hand, that bequeathing vast fortunes to one's descendants too often serves an unhygienic purpose, removing them from the necessity of healthful labor and alienating their sympathies from the toiling masses.

**Loss through Accidents.** — The yearly sacrifice of health and life on account of preventable accidents is almost unbelievable. It is estimated that there are killed daily by the railroads of the United States an average of twenty-six people, and there are wounded by the railroads a daily average of two hundred and thirty people. These numbers foot up to nearly one hundred thousand people killed or wounded by the railroads in a single year. But the railroads are not the only means through which people are accidentally injured and killed. We have automobile and motorcycle accidents, and accidents from vehicles drawn by horses and mules. There are terrible accidents in mines, upon water, and in the air.

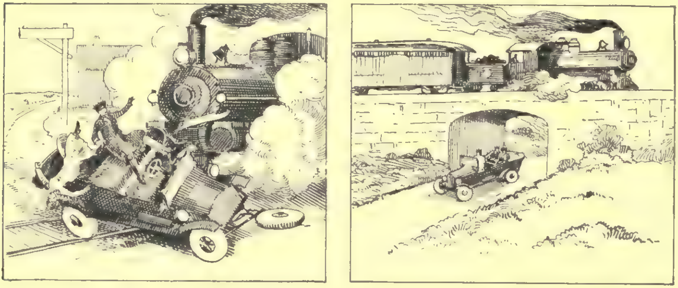

FIG. 91. FIG. 92.

**The Most Frequently Occurring Accident** of a serious nature in the United States today and the simple method of preventing it.

Thousands are accidentally destroyed by firearms and explosives. There are also numerous accidents in the construction of buildings, in the running of machinery, in athletic contests, and in numerous other ways.

Negligence and lack of forethought are the chief causes of all accidents. That precautionary measures are generally lacking in hazardous occupations in this country and that the American people, individually and collectively, are inexcusably careless in the matter of safeguarding life, has been revealed by numerous investigations.

Though some progress has been made, we have much to learn in the prevention of accidents — much which the older civilized countries can teach.[1]

**Health Control and Self-Control.** — Success in controlling the health not infrequently depends upon one's ability to control his natural instincts and desires or to inject into his life some element not provided through the automatic mechanism of control or supplied by the vocation. The indoor worker must force upon himself a régime which gives sufficient physical exercise, and one having a bad posture must use will power in securing correctness of form. Restraint is necessary in eating, in nervous conservation, and in social relations. Narrow is the way sometimes which leads to health, and only the person who has himself well in hand is able to follow it. Especially is a high degree of control necessary when one is called upon to break some habit which interferes with health or when he must submit to great restrictions in order to combat disease successfully. In such crises victory is attained only by the self-controlled and the determined.

**Self-Discipline.** — To have the strong and controlling mind when health, and even life, is at stake, requires more or less training or discipline in things of minor importance. Opportunity for such training is, moreover, not difficult to find, since in the daily routine of doing what is best there is much which requires effort of the will or determination. By doing, at one time, what comfort and self-indulgence would cause us to leave undone, by restraining, at another time, the instincts and desires which, if indulged, would weaken character or lower the tone of health, and by avoiding the path of least resistance when this leads downward, we gradually gain the control over self which is so essential to all kinds of success. Everyone should have definite rules for his guidance, such as the following:

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[1] In England no unauthorized person is permitted to walk upon a railroad right of way; railroad crossings are obviated either by bridges over or tunnels under the road, and all necessary precautions for preventing accidents in the running of trains are enforced by law. As a result England has comparatively few railroad accidents.

1. When there is some unpleasant task to perform, do it at the earliest opportunity and do it well.
2. Observe a regular time for rising and retiring.
3. Eat and drink nothing simply to gratify the appetite, but consider the needs of the body and satisfy these in the best manner possible.
4. Never omit the daily exercise unless prevented by sickness or by exhaustion from the regular work.
5. Observe regular periods for bathing and cultivate neatness of person.
6. Control the tongue and the temper.
7. Avoid formation of detrimental habits and overcome such as have been formed.

**Effects of Indolence.** — Self-discipline becomes easier if there be some regular and natural outlet for the bodily energies, but immensely more difficult if there be an inclination to avoid effort (page 290). The relation of indolence to the formation of pernicious habits is well known. "When a man shuns effort, he is in no position to resist temptation," and "through all the ages, idleness has been known as the parent of the vices."[1] In the indolent person are to be found pessimism, ennui, and cowardice. Indolence is a condition in which the bodily energies are turned back upon self and this, plus the vicious habits engendered, makes strongly for disease.

[1] David Starr Jordan, *The Strength of Being Clean.*

Because regular and productive labor supplies a natural outlet for the energy (page 244) and fosters good habits, it is one of the best general safeguards of health.

**Loss through Pleasure.** — The greatest temptation to self-indulgence is the prospect of immediate reward in some kind of pleasure. Although pleasure is not in itself objectionable, but is to be counted generally as a condition making for good health, we must distinguish between pleasures based upon normal activity and those that entail a risk or exact a heavy toll of bodily energy. Unless one discriminate between pleasures that are innocent and healthful and those that are immoral and disease-producing, the pleasure seeker is very likely to sacrifice his physical well-being. Pleasure which lays a heavy tax upon the nervous system, which endangers health, or which deprives others of happiness, should be studiously avoided.

The best solution of the problem of pleasure is to find the great joys of life in everyday, commonplace affairs — in work, the association of friends, the study of Nature, the activities of children, etc. This happy solution, however, comes not through self-indulgence but through the effort to put the entire life upon a high plane.

**Loss through Habits.** — Habits are the grooves which fix the general course of life. If habits are such as make for good health and happiness in the true sense, well and good. If they are tendencies toward pleasures that mar and toward methods of living that are unhygienic, they become the easy means through which control is lost. *One must be master of his habits.* He must be able to acquire those that are beneficial and rid himself of those that are harmful. If this result cannot be attained, the bad habits and not the mind are apt to rule the body.

Whether the mind be able to overthrow some established habit depends upon the energy and earnestness with which the habit is attacked, upon the length of time it has been indulged, and upon the nature of the habit itself. The habits most difficult to break, and those most detrimental to health, are those having to do with the use of drugs. Freedom from drug habits should be secured by all means (page 250).

**How Control is Lost through Habit-forming Drugs.** — There are three general methods by which habit-forming drugs interfere with the control of the health.

1. By interference with the automatic system for controlling the body (page 36).

2. By interference with the vital processes.

3. By interference with the normal nervous discharges such that distress and ill health are experienced when the use of the drug is discontinued.

The first of these effects has already been discussed (page 156). The second is perhaps most strikingly illustrated by the alcohol habit and the third by the tobacco habit. Most drugs produce all three effects to some extent.

**Loss of Control through Alcohol.** — The following facts, referred to in preceding pages, are fully substantiated:

1. Alcohol causes poverty and crime, which in turn cause disease.

2. Alcohol lowers the body resistance (page 336) and renders the body more liable to attacks of germs.

3. Alcohol interferes fundamentally with the chemical processes of the body, and by so doing is an active cause in the production of all the diseases that result from impaired metabolism.

4. Alcohol poisons the germ, or reproduction, cells of the body and by this means places a burden of physical weakness upon the offspring.

5. Alcohol injures the nervous system and induces mental and nervous diseases, including insanity. This last effect interferes with all kinds of bodily control in the broadest sense.

The observation of Shakespeare "that men should put an enemy in their mouths to steal away their brains," is more than verified by the records of our modern hospitals for the insane. According to Professor Rosenau, "Alcohol, as a predisposing or immediate cause, is responsible for more than one-third of the admissions to our insane hospitals."[1] What more striking proof could there be for the necessity of avoiding alcohol by those who would control the health?

**Loss of Control through Tobacco.** — In the establishment of a drug habit, the nervous system adjusts itself to the effect of the drug in question, and this means that a readjustment must occur when the drug is discontinued. Because of the difficulty with which the readjustment is accomplished, unpleasant and sometimes serious conditions result when the drug is omitted.[2] Effects of this kind are quite frequent with the users of tobacco. While most young men have little trouble in breaking the tobacco habit in its early stages, a large number experience much difficulty when it has been thoroughly established by a long period of indulgence. Some tobacco users are fond of saying that they will break the habit when it is seen to be injurious. The time to break the habit is before this stage is reached. The body can then make its adjustments without serious disturbances.

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[1] Milton J. Rosenau, *Preventive Medicine and Hygiene.*

[2] A mild effect of this kind is the headache which results when a coffee drinker omits the morning cup.

Tobacco irritates and exhausts the nervous system, excites the heart, raises the blood pressure, and in some instances produces blindness by atrophy of the optic nerve. Smoking irritates the lips and air passages and lays a foundation for diseases of the mouth (page 407), throat, and lungs. With young people it interferes with school work and with normal growth and development. The boy who uses very much tobacco will not attain the growth of body and of mind which he would have attained without it. One who would control health will find the problem much easier if he avoids this enemy of his body.

**Loss of Control through Failure to Control the Sexual Instinct.** — Not the least of the many ways through which control of health is lost, is failure to control the instinct which has for its purpose the perpetuity of the race. This instinct, when controlled and regulated according to correct social standards and the demands of health, makes for the happiness of the individual and the welfare of future generations, but when not so controlled and regulated, has a degenerating effect upon the individual and society at large, becoming in some instances the most potent of all causes of ill health (pages 237 and 360). Since each normal human being "is a link in a continuous chain, going back to the beginnings of life," he has no more serious responsibility than that of guarding, in a proper manner, the life-chain of which he is a part.

**Summary.** — Health control, gained often by much study and effort, is easily lost in a variety of ways. The individual must be alert and on his guard. He must not be ignorant of the principles of health control nor fail to put them into practice; and to supply the material basis for health, most people should live economically. Appetites, desires, and instincts need to be kept well in hand, and one must discriminate in his pleasures. Habits that make for good health must be built up; those detrimental to health, or that subject one to undue liabilities, must be overthrown. The body must be kept free from the effects of drugs and the most perfect control exercised in matters of sex.

**Exercises.** — 1. State the general method by which control of health is lost.

2. How may ignorance lead to loss of control? Explain the general tendency for people to neglect health. In what ways does poverty cause ill health?

3. How may wealth destroy health? How may wealth be a means of improving health? How may the wealth of one person become a source of health to another?

4. State the chief causes of accidents. What may the individual do to prevent accidents? What should the state do?

5. How may a lack of self-control lead to the loss of health control?

6. Explain the effect of indolence upon the health.

7. What forms of pleasure lead to loss of health? What kinds tend to improve the health?

8. Explain the beneficial and harmful effects of habits in controlling health.

9. What special dangers attend the use of drugs?

10. Enumerate the effects of alcohol upon the health.

11. Enumerate the harmful effects of tobacco.

12. Why should drug habits be broken up even when they are apparently doing no harm? Give rules for breaking a drug habit.

### Health Work

The topics considered in the present chapter suggest the great importance of living in accordance with some well-formed plan. While planning each day so that hygienic needs are supplied (page 315), the individual should lay out, so to speak, the general course of his life. To carry out successfully such a life plan requires, among other things, the development of a special attribute or quality of mind — that of *persistence*. The value of persistence is especially apparent in the establishment of health-giving habits and in the overthrow of habits that are detrimental.

**Persistence and the Change of Habits.** — If habits are the grooves which fix the course of life, how important that they be of the right kind; how necessary that habits conducive to good health be formed and that those detrimental to health be broken! The simple methods of accomplishing these results is *persistent effort* to do the right thing and to live up to our ideals. Every proper action is a step toward the formation of a desirable habit, and every successful resistance to a bad habit is a step toward its overthrow. Because changes in the nervous system upon which changes in habits depend, require time as well as effort for their accomplishment, those lacking in persistence will hardly succeed in reconstructing their habits. But even this quality can be cultivated. Hence instead of being discouraged by occasional failures, one should, when these occur, renew his efforts with increased determination. Since most of the rules previously suggested (pages 159 and 250) for the breaking of drug habits apply to habits in general, these may be profitably reviewed at this time.

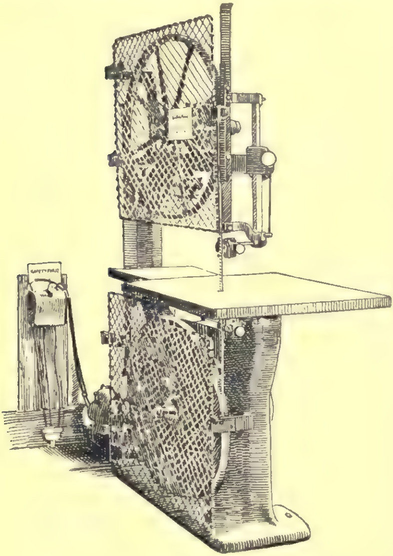

FIG. 93. — **Screened in Wheels and Saw Blade** for the protection of the workmen. The great increase in the number and kinds of safety devices in all work involving risk is indicative of our growing desire to prevent accidents.

**Precautions for the Avoidance of Accidents.** — The wide-awake, composed, but active mind is the best possible guard against immediate danger of any kind. Through the special senses, the mind quickly familiarizes itself with the environment and then determines what action or series of actions is best. But more important than alertness on the special occasion is a well-fixed habit of exercising caution under all circumstances. General and special rules covering one's liabilities should be laid out and closely adhered to, such as the following:

1. In working with machinery, see that the moving parts, such as wheels, belts, chains, and cogs, are protected by guards and shields and that the hands and clothing are not unduly exposed (Fig. 93). Do not stand under or too near a load of any kind that is being raised or lowered and do not attempt to repair, adjust, or oil moving machinery unless this be unavoidable and all necessary precautions are taken. Study the causes of accidents by machinery and make the fullest possible use of safety devices.

2. If an engineer, motorman, or chauffeur, learn and strictly observe all the rules for avoiding accidents, placing "safety first" under all circumstances. Be sure that eye defects, if present, are properly corrected. Poor vision is responsible for many accidents; eyestrain by causing nervousness and dizziness may also be responsible.

3. In exposing oneself on a high building be sure that scaffolds, ropes, or other supports are perfectly sound and whenever possible use a safety belt (Fig. 94).

4. Take all reasonable precautions in handling firearms and explosives. Do not keep firearms in the house as a means of burglar protection. Find some saner method of celebrating the national birthday than by the use of explosives.

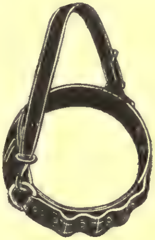

FIG. 94. — A **Safety Belt** used by linemen in electric lighting, telegraph, and telephone work.

5. Guard the home and place of work against possible fires. See that there are no accumulations of waste and rubbish which may take fire spontaneously. Find some safe substitute in the home for the dangerous gasoline stove. Be sure that the chimneys and flues are sound and that they extend a sufficient distance above the roof.

6. Never touch the street wires for conducting electricity. If the house wires need repairing or adjustment, call in the electrician.

7. In traveling, patronize those railroad and steamship lines that emphasize the element of safety. If possible avoid the occasions when passenger traffic is congested.

8. Avoid liquor under all circumstances, but more especially when exposed to conditions under which accidents are possible.

**Rules for "Getting Ahead."** — While the solution of the problem of supplying the material basis for health must vary with the individual, there are certain general rules which all may follow:

1. Control health. Poor health entails extra expense and is likely to stop the daily wage.

2. Limit expenditures to essential needs — those related to health, to efficiency in a broad sense, and to education.

3. Avoid tobacco, alcohol, coffee, soft drinks, and other substances which waste money, and often health, and give no substantial return.

4. Through good taste and neatness in the use of plain apparel, make the expensive and showy garments which one cannot afford unnecessary.

5. Find pleasure in the simple and wholesome things of life — those that make slight draft upon the purse and none upon the health.

6. Keep down the false pride that would cause one to live beyond his means.

7. Acquire efficiency in more than one line of work. This will frequently enable one to avoid loss from lack of employment.

8. Supplement the income by utilizing the leisure moments.

9. Establish the habit of saving. One gets ahead not by what he earns, but by what he saves from his earnings, and then "money at interest is a good silent partner."

## CHAPTER XXII

## HEALTH CONTROL AND THE PERSONAL EQUATION

"First to thine own self be true." — *Hamlet.*

Two persons eat the same amounts of the same kinds of food. One derives energy and tissue building material; the other has acute indigestion. Two boys go swimming and remain in the water the same length of time. One is benefited by the exercise; the other is indisposed for some days. Corresponding differences in effect are observed in the application of practically all hygienic principles. To accomplish the desired results they must be adapted to the special needs and the physical condition of the individual. Upon this point often hinges the control which we seek.

**Differences in People.** — In no other respect perhaps are the differences among people so great as in matters pertaining to health. Age, sex, occupation, the nervous temperament, weaknesses resulting from disease and accident, inherited tendencies, and the physical and social environment, all present differences which must be taken into account by the individual in controlling his health. Even the differences in our relations to, and responsibility for, other people have a bearing upon the problem which cannot be ignored. This means that no two persons have exactly the same health problems and that no two can apply health principles in exactly the same manner. Each is to some extent a law unto himself.

**Adjustments to Offset Inherited Tendencies.** — Although "like begets like," many inherited weaknesses and tendencies can be overcome through individual effort. The tendency to tuberculosis, for example, can be almost entirely removed by methods (page 332) which strengthen the lung surfaces and increase the general bodily resistance. Hence those having such a tendency should adopt at once a mode of life which avoids the impending danger. The mistake should never be made of calmly submitting to any kind of weakness or defect which our parents have had before us and of making no effort to overcome it. In many instances the observed weakness is not an inheritance at all, but a result that has developed alike in parents and children from their living under the same conditions. For example, the eating by members of a family of the same food preparations will, if these be unwholesome, cause them to have the same digestive troubles, while poor ventilation of the home will cause them to have respiratory weaknesses of a similar nature. One having any kind of bodily weakness, whether it be a family trait or not, should earnestly seek relief, employing both hygienic measures and medical aid to this end.

**Personal Adjustments and Nervous Weakness.** — Too frequently does one afflicted with some nervous disorder which his parents had before him, take the view that he is doomed to a condition from which there is no escape. While the fact is well established that nervous weaknesses are to some extent inherited, the inheritance is just as apt to be some remediable physical or mental condition which interferes with nervous expenditures, as some inherent weakness of the nerve cells. For example, eye defects are hereditary and the strain resulting from them may cause insomnia, intense nervousness, chorea, and according to some authorities, epilepsy and insanity (page 260). Nervous weakness may also result from failure to control the emotions, a characteristic which may be inherited, but one which is more likely to be acquired by imitation. The fact that these conditions are remediable and the further fact that the chief causes of nervous diseases are the social, economic, and physical conditions to which the individual is exposed, is most suggestive from the standpoint of nervous hygiene.

The presence of nervous weaknesses from any cause calls for personal adjustments which lessen the nervous expenditures. One should find the continuously acting causes (nerve leaks) which waste his nervous energy (page 231) and see that these are removed. He should also supply conditions, such as sleep, physical exercise, and rest and relaxation, that are essential to the renewal and invigoration of his entire body.

**Adjustments and Chemical Weakness.** — That one whose chemical processes are impaired must exercise greater care in the use of foods than one whose processes are normal, has already been sufficiently dwelt upon (pages 130–138). From failure to make proper adjustments to meet this condition, serious diseases will sooner or later result. The individual must not make the mistake, however, of accepting diminished chemical power as a permanent condition which necessitates permanent restrictions of diet, but while selecting foods to meet his present requirements, he should make such adjustments in his mode of life as will increase the vigor of his cells and improve digestion (Chapters VI and IX).

**Adjustments to Lesson the Work of Vision.** — On account of the broad range of visual defects and the differences in nervous expenditure which these entail, personal adjustments are required of every person who does much close work. These include the length of time and the manner in which the eyes are used, the nature and the intensity of the light employed, and the fitting and wearing of glasses. Visual adjustment is essential to health and efficiency, and as a condition of successful work is worthy of much more attention than it receives. The hygiene of the eye as set forth in Chapter XIII should be generally understood and should be so applied as to meet individual needs.

**Other Adjustments from Bodily Weaknesses.** — Bodily weaknesses are so varied that the adjustments which need to be made on account of them present the greatest variety. In addition to those already considered the two following are often necessary:

1. Adjustments to protect some part of the body which is weak, as, for example, the protection of an injured limb until healing is complete.

2. Adjustments for the recovery of health after some wasting disease or severe strain. There is perhaps no other adjustment of exercise, outdoor life, and health agencies generally, quite so delicate as that which is necessary when the body has been reduced through disease. A mistake at this time usually causes a relapse.

**Outdoor and Indoor Workers.** — Fully as important as differences in bodily condition in determining what personal adjustments should be made, are the differences in environment. Even the matter of whether one is an indoor worker or an outdoor worker makes a vast difference in his personal problems of health. If one's work is mostly out of doors, he may cease to give conscious attention to certain matters that vitally concern the indoor worker. He will get sufficient fresh air as a matter of course, and in most cases the problem of exercise is solved through the outdoor work. There are numerous problems, however, which require special attention. Many outdoor occupations, such as farming, demand the expenditure of vast amounts of bodily energy so that one is in constant danger of overwork and strain. Others, such as construction work, present liabilities from accidents; and others, such as house-painting and stonecutting, subject one to special causes that make for disease. It is thus seen that the outdoor worker, as well as the indoor worker, has special problems, and that continued good health depends upon their solution.

Since, however, the indoor worker is farther removed from the natural life to which he is adapted than the outdoor worker, many more things require his attention. The proper ventilation, lighting, and heating of the place in which he works, become matters of vital concern, and daily provision must be made for exercise. His food must usually be adjusted to a condition of low bodily vigor, and in most instances his nervous energy must be carefully conserved. In addition to all this, there may be special conditions depending upon the occupation that tend to undermine the health, and these must be avoided or counteracted. It is fundamental that the indoor worker be informed concerning his special liabilities and that he be persistent in the application of corrective agencies.

**Adjustments on Account of Occupation.** — The adjustments necessary on account of occupation for securing health conditions, present as much variety as the occupations themselves. Some of the more obvious matters requiring attention are the following:

1. *To avoid stooping positions.* — Students, mechanics, seamstresses, stenographers, bookkeepers, and many others should include in their regular régime for controlling the health deep breathing exercises and the special muscular movements described elsewhere (page 82) for overcoming postural defects. Effort should also be made to perform the work in question in such a way that a normal position may be easily maintained (pages 79 and 85).

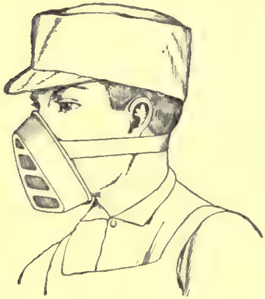

FIG. 95. — **The Respirator** — a device for removing smoke and dust from air which is breathed. Respirators are also made which remove noxious gases.

2. *To avoid dust.* — While the lungs of the Esquimo are light pink in color, the lungs of the coal-heaver are black and those of the city dweller are brown. These striking facts, however, do not tell the whole story of the effects of the inhalation of dust. Those compelled to breathe the gritty dust from the cutting and crushing of stone or the sharpening of tools supply a large percentage of the cases of tuberculosis. One precaution from dust is to breathe through the nostrils, but in many instances this is insufficient. Though special contrivances for separating dust, called respirators (Fig. 95), are sometimes worn over the faces of workmen, the most effective means for avoiding this source of danger is through devices which prevent dust from rising in the air. The usual method employed in manufacturing establishments is to remove the offending dust by air currents produced by fans.

3. *To avoid chemical poisons.* — In manufacturing industries dependent upon chemical processes or employ-

ing chemicals, the workmen are frequently exposed to substances of a poisonous nature. Workmen in match factories, gas works, and in all kinds of industries producing chemical reagents, are confronted with the problem of avoiding the effects of injurious materials. While the problem is sometimes solved through a method of manufacture which eliminates the poisonous element, as in making mirrors by depositing silver instead of mercury upon glass and in the manufacture of matches from red instead of yellow phosphorus, and sometimes by collecting and utilizing the harmful substance, as in the conversion of sulphur dioxide from smelting works into sulphuric acid, in some instances the only solution for the individual is the avoidance of such occupations.

4. *To prevent accidents.* — Adjustments to prevent accidents are of two general kinds — individual precautions (page 447) and precautions having to do with the removal of accident-inducing conditions. Success in preventing accidents necessitates the fullest coöperation of workmen, foremen, and superintendents.

5. *To prevent the spread of disease.* — This includes attention to the ventilation, heating, and lighting of places of work and to such matters of personal hygiene as prevent individuals from acting as carriers of germs (page 386).

**Adjustments on Account of Age.** — Problems of health naturally vary with age. On account of demands made upon the organism by growth, the serious responsibilities of life should not fall heavily upon those below twenty. While children should form habits of industry, they should not be subjected to strain of any kind. To the extent that bodily welfare permits, the young person is to be trained mentally, but education must not be at the expense of bodily development. Variations which need to be observed on account of age include the following:

1. *As to sleep.* — The infant should sleep most of the time, but from this period to maturity the amount of sleep should be gradually diminished. Seven to eight hours a day are required by the average adult, but children under twelve require at least ten hours. Old people require perhaps less sleep than those in middle age, but never more.

2. *As to exercise.* — In no period of life should the amount of physical exercise exceed one's capacity for generating energy. Because the old person has less energy for external use than the youth or the one in middle age, he must take less exercise. On account of degenerative changes in his tissues, he must also omit exercises of a violent nature. The old person should not make the mistake, however, of curtailing exercise to the point of withdrawing a needed stimulus to his vital processes (page 221).

3. *As to mental work.* — Mental work of a serious nature may be begun at the age of eighteen or twenty and continued throughout life, provided the conditions necessary to all-round bodily vigor are maintained (Chapter XV).

4. *As to food.* — On account of growth, the young person needs more food and a slightly larger proportion of proteins than is needed after maturity. In old age any excess of food should be avoided and all foods tending to leave a residue of wastes (page 131) should be curtailed. A special adjustment seemingly needs to be made in the use of milk. On account of the changes in the digestive fluids, fresh milk should not be used freely by adults. Buttermilk and curded milk, on the

other hand, are excellent protein foods for those in middle and advanced age.

5. *As to elimination.* — Serious during all periods of life, the problem of elimination becomes more difficult as one advances in years. Because efficiency during old age is almost directly related to the elimination of waste, the old person must give much attention to the conditions (Chapters IX and X) upon which good elimination depends.

**Differences due to Sex.** — Certain modifications in the applications of health principles are necessary on account of sex. Because of natural differences, as well as differences in dress and methods of bringing up, girls are more easily injured than boys, and this necessitates for them a somewhat more closely guarded mode of life. Generally speaking, girls should avoid:

1. Heavy lifting, especially that which strains the back or the hips.

2. Jumping from high elevations.

3. Severe and long continued exposure to wet or cold.

4. Heavy gymnastics and games of a highly strenuous nature. Much, however, depends upon the physical condition and skill of those participating.

5. Long continued and exhausting work of all kind.

**Dangers from Mental Overwork.** — The last-named precaution is particularly applicable to severe mental work and to other activities that exhaust the nervous system. While many young women shrink from an occupation requiring much muscular work, it is a fact that they are less apt to be injured by such occupations than by those that severely tax the nerves. To supply a heavy draft of nervous energy requires a vigorous, well-nourished body, and this the woman worker too often lacks. While teaching and other kinds of mental work, on account of the sheltered environment, appeal strongly to women thrown upon their own resources, these should not be entered upon without due regard to bodily qualifications. The results from overlooking this factor may be most serious.[1]

**The Need for Better Physical Development on the Part of Women.** — A comparison of the sexes among savage and primitive peoples shows that the body of woman is naturally but little weaker than the body of man. Indoor life, the method of her bringing up, her mode of dress, and prevailing styles and customs, however, have so interfered with normal development that the average modern woman is scarcely more than half as strong as her male companion. If the difference were only a matter of physical strength, it would be of slight significance, but the modern woman is weak in chemical processes, in her nervous system, and in her resistance to attacks of disease. These weaknesses diminish her capacity for attainment and too often thwart the main purposes of her life.

Since the causes upon which these weaknesses depend still exist, in fact may never be removed, woman's struggle for physical vigor requires greater effort of the will and more planning than that of man. Not only is special effort required of the individual woman, but the full solution of the problem necessitates a readjustment of our ideas concerning woman's welfare as a class and changes in the methods of certain of our institutions, especially the school and the home.[1]

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[1] The prospective teacher should strive earnestly for that degree of health which makes the teacher's work a success, and which prevents nervous weaknesses and the general decline of physical vigor which is so frequently experienced by teachers.

**Personal Problems of Men.** — Men are the protectors of homes and of the nation. In time of peace they are the bread-winners and in time of war they must risk health and life for the general welfare. All the occupations requiring great physical exertion and bodily risk are filled by men. The average man must be courageous, physically capable, and prepared for emergencies. Hence in his development he must seek rather than avoid those activities which develop strong physical qualities even though they be attended by risk. The competitive games of school and college, while they must be entered into with due consideration for health, are in line with the development of qualities that characterize men as men.

**Power through Control.** — But while the young man should seek the activities which develop strength of muscle, endurance, and physical courage, he must never lose sight of the fact that his most important attribute is his *power of control* — control of temper, of animal instincts, of habits, and of his activities in general. Because his mode of life exposes him naturally to temptations, he should seek every means of gaining that self-mastery (page 439) which is his best safeguard. In securing control he will adapt hygienic principles to all things that make for the development of manhood in the best sense.

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[1] Obviously the maturing girl and the adult woman have had no control over the most important period of their development — that of early childhood. While the small boy was engaged in vigorous exercise out of doors, the little girl too often was indoors with her dolls and her books. It remains for the modern hygienic home to provide *equally* for the development of its boys and its girls.

**Hygienic Sacrifice.** — Should one ever willingly ignore the laws of health? From the standpoint both of the individual and of society the question must be answered in the affirmative. For his own advancement supreme tests of strength and endurance are sometimes necessary, and for the sake of friends, relatives, or the community at large, one may be required to lower the tone of health and at times risk even his life. So great is the social necessity for sacrifice that the state of mind which prompts it appears instinctive in the human being. Parents sacrifice naturally for their children; soldiers boldly face death for the sake of country; and heroes in private life gladly take great risks in order to rescue those exposed to danger. While there is no general rule governing such sacrifices, one cannot, as a matter of principle, permit consideration for his own health to stand in the way of duty or to make of him a coward.

In responding to a call which means sacrifice, however, one should be prepared to make his efforts count, and this necessitates the possession of bodily vigor which comes only from right living. The hero cannot be a physical weakling. It is also a great advantage to those exposed temporarily to unhygienic conditions to understand health principles, since this enables them to avoid unnecessary risk and to recover more quickly from injuries that may result.

**Personal Hygiene a Social Obligation.** — Throughout our course we have emphasized the advantage to the individual of controlling his health. However, if such advantage were confined to the individual, the entire system which we have advocated would be more or less objectionable, and because of the selfish tendencies which it would engender. But it is not for ourselves alone that we are to practice health control. Through the possession of health we avoid becoming burdens upon our friends or upon society. If one is physically vigorous he can the better endow his offspring and provide for those dependent upon him. One who keeps himself well can spread more happiness through the world and more often lend a helping hand. Hence to live the hygienic life is as much a duty which we owe to others as it is a means of advancing personal interests; by being true to ourselves in matters of health we become more efficient members of society.[1] *Good health for self that we may benefit others* is, indeed, a lofty and inspiring motive — one that should keep us ever active in applying *The Principles of Control.*

**Summary.** — Since people differ greatly in bodily condition and in the influences and agencies to which they are subjected, their health problems must be worked out along different lines. Proceeding upon the general theory that health is secured through the manipulation of causes that affect the cells (page 33), we have the special problem of adapting well-known principles to existing bodily conditions and circumstances. Personal adjustments are necessary on account of occupation, age, sex, inherited and acquired weaknesses, and social and physical environment, and are demanded both by the needs of the individual and the requirements of the social order.

**Exercises.** — 1. Why cannot all people follow the same plan in controlling the health?

2. What special lines of health work must be followed by one having nervous weaknesses? By one run down in bodily vigor?

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[1] On account of social relationships it can never be truly said of one who has led a dissipated life that "he injured no one but himself." It is never possible for one to injure himself without injuring others at the same time.

3. How do eye defects cause health problems to vary among different people?

4. State the general differences in health problems between indoor and outdoor workers.

5. Why must stooping positions be avoided? What measures are necessary for this purpose?

6. What variations in the amount of sleep must be made on account of age? In the kind and amount of exercise? In the use of foods?

7. Will greater harm result from overeating in the young or in the old person? Why?

8. What general differences should be recognized in the physical exercises of young men and women?

9. Why must the young woman give special attention to the problems of health?

10. What is meant by hygienic sacrifice? How are such sacrifices justified?

11. How does looking after one's own health redound to the benefit of others?

12. Summarize the different lines of hygienic effort studied during the entire course.

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